96-0003037

Department of Energy
Washington, DC 20585

July 31, 1996

The Honorable John T. Conway
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, NW
Suite 700
Washington, D.C. 20004

Dear Mr. Chairman:

Enclosed is the "The Current and Planned Low-Level Waste Disposal Capacity Report," Revision 0. This report is a deliverable pursuant to the commitment in Task Initiative VIII.B.1 identified in the Department of Energy's Implementation Plan, Revision I, for the Defense Nuclear Facilities Safety Board Recommendation 94-2.

This report contains life cycle volumetric projections of the future generation of low-level waste by the Department of Energy and provides a comparison of the projections with current and planned disposal facility capacity. The report is based on existing available data and estimates. The report concludes that improved volumetric projections are required. These improvements will occur with the development and implementation of the projections program guidance, a deliverable which is due on December 31, 1996, under Task VIII of the Implementation Plan for Recommendation 94-2. A revision of the report, which is scheduled for September 1997, will address radiological projections and related capacity. The revision will also include improved volumetric projections.

The Department has completed the actions identified under this commitment for preparation of the Revision 0 report and proposes closure of the commitment as it relates to Revision 0. However, work will continue on this task for other commitments as noted above.

Sincerely,

Alvin L. Alm

Alvin L. Alm
Assistant Secretary for
Environmental Management

Enclosure

96/3037

The Current and Planned Low-Level Waste Disposal Capacity Report
Revision 0

July 30, 1996

U.S. Department of Energy
Office of Environmental Management

Executive Summary

In response to the Defense Nuclear Facilities Safety Board's Recommendation 94-2, the U.S. Department of Energy is establishing a uniform program for forecasting future low-level waste (LLW) disposal needs, taking into account ongoing missions and projected cleanup activities. As a first step in developing this uniform program, the Department has prepared The Current and Planned Low-Level Waste Disposal Capacity Report. The Report provides life cycle volumetric projections of Department of Energy LLW and compares these projections with estimates of the current and planned volumetric disposal capacity at Department of Energy disposal facilities. In addition, this Report provides life cycle volumetric projections of Department of Energy mixed low-level waste (MLLW). Based on the development of this Report, the Department has concluded:

(1) While recent data collections have improved the quality of LLW and MLLW projections, additional work remains.

(2) An analysis using volumetric data and criteria provides only a very approximate estimate of disposal capacity.

(3) A cumulative radiological analysis is required when determining disposal capacities for facilities operated by the Waste Management program and Environmental Restoration program when source term interaction exists.

(4) The Environmental Management program currently is preparing a Ten Year Plan to complete cleanup at nuclear sites within a decade, which may vary the amount and rate of LLW generated in the future and the Department's strategy for the waste.

This Report was compiled primarily using existing available data sources. As a result, there is variation in the quality and consistency of the data. This is due in large measure to the fact that a common methodology does not exist to estimate future waste projections. Additionally, the Department does not believe the present projections data are sufficient for estimating or planning disposal capacity. The Department plans to address this deficiency by establishing a LLW projections program which will provide a uniform approach and integrated methodology for developing and maintaining high quality and consistent LLW projections throughout the Department. A guidance document describing the projections program is scheduled for release in December 1996.

As noted, the analysis and findings in this Report are based solely on volumetric criteria. The Department recognizes that radiological performance assessment information is needed to provide a more accurate evaluation of disposal capacity. The required radiological information will be provided in Revision 1 of the Report due to be completed by September 1997. Revision 1 also will be based on methodologies developed from and data collected based on the LLW projection guidance document.

Finally, the Department recognizes that increased coordination between the Environmental Restoration and the Waste Management programs is needed on waste projections and disposal capacity issues. Conducting performance assessments and determining disposal capacity from a radiological perspective requires an evaluation of all interacting radiological sources. A cumulative radiological analysis is required when determining disposal capacities for facilities operated by the Waste Management program and the Environmental Restoration program at a given site when source term interaction exists.

Major findings and conclusions regarding waste projections, current waste disposition strategy, and disposal capacity are summarized below.

Waste Projections

The Department projects that over the next 75 years (FY 1996 - 2070) its cleanup activities and ongoing missions will generate approximately 13 million m^3 of LLW and 810,000 m^3 of MLLW.

- Stabilization and deactivation activities performed by the Nuclear Material and Facility Stabilization program will generate approximately 100,000 m^3 of LLW and 32,000 m^3 of MLLW.

- Remediation and decommissioning activities performed by the Environmental Restoration program will generate approximately 9.8 million m^3 of LLW and 460,000 m^3 of MLLW[1].

- Other Department of Energy missions (e.g., Defense Programs, Energy Research, and Nuclear Energy (including the Naval Reactors program)) as well as the Waste Management program will generate 2.8 million m^3 of LLW and 220,000 m^3 of MLLW.

- The Waste Management program also is responsible for the final disposition of approximately 170,000 m^3 of legacy LLW and 100,000 m^3 of legacy MLLW in storage.

Current Waste Disposition Strategy

The Department's current strategy for disposition of the projected 13 million m^3 of LLW and 810,000 m^3 of MLLW is outlined as follows:

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[1]Approximately 56 million m^3 of environmental media and facilities contaminated with radionuclides are in the scope of the Environmental Restoration program. Final determination of the disposition of the contaminated media and facilities will be developed pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act and the Resource Conservation and Recovery Act regulatory processes. The current strategy for the majority of this material is either no further action or in-situ remediation strategies. A disposition strategy for a fraction of this material (approximately 10 million m^3) has yet to be determined but is expected in the near future.

- Approximately 7.8 million m^3 of LLW and 330,000 m^3 of MLLW from environmental restoration activities will be managed by the Environmental Restoration program.

  -- 5.8 million m^3 of LLW will be disposed in current and planned disposal facilities designed solely for on-site remediation wastes and operated by the Environmental Restoration program;

  -- 1.6 million m^3 of LLW and 35,000 m^3 of MLLW will be transferred to commercial disposal facilities (the Department currently transfers waste to the Envirocare disposal facility in Utah; other commercial disposal facilities will be considered as they become available); and

  -- specific waste disposition strategies for approximately 390,000 m^3 of LLW and 290,000 m^3 of MLLW have not yet been identified.

- Approximately 5.0 million m^3 of LLW and 480,000 m^3 of MLLW will require disposal at facilities operated by the Waste Management program.

- Treatment and volume reduction technologies will further reduce these LLW and MLLW volume projections, lessening disposal capacity requirements.

<u>Disposal Capacity</u>

To meet LLW disposal requirements, the Department has current and planned available disposal capacity of 11.5 million m^3 and plans to send to commercial facilities approximately 1.6 million m^3 of LLW. Therefore, on a complex-wide basis the current and planned available disposal capacities of the Department's disposal facilities appear to be adequate for managing the projected LLW volumes for the foreseeable future. In addition, the volume of LLW requiring disposal likely will be less than the reported projections when the following two factors are considered:

- the analysis in this Report did not consider any volume reduction prior to disposal (a number of sites either have implemented or are evaluating significant volume reduction initiatives to reduce the volume of waste requiring disposal); and

- a waste minimization strategy for LLW is being developed as part of Task VIII.3.a of the Defense Nuclear Facilities Safety Board Recommendation 94-2 Implementation Plan (Revision I). As recommendations from this Task will be incorporated into the Department's waste minimization program, the volume of waste requiring disposal will be reduced.

In addition, should future LLW projections exceed those contained in this Report, a number of steps could be taken to accommodate the increased disposal needs. Several potential on-site Department of Energy disposal facilities were not included in this analysis because they are considered very preliminary. Should additional disposal needs be projected, these facilities could be developed. In addition, the Department is investigating the increased use of commercial disposal facilities.

While this analysis determined that there is adequate disposal capacity on a complex-wide basis, changes in site-specific waste management and disposition strategies (e.g., increased volume reduction, off-site shipment configuration, greater use of commercial facilities, and increased on-site disposal) may be required. A site-specific summary of LLW disposal capacity follows:

- Fernald Environmental Management Project has planned sufficient disposal capacity for all of its on-site disposal projections.

- Hanford Site's waste management and environmental restoration disposal facilities have sufficient volumetric disposal capacity to meet the projected waste disposal requirements through the projected life cycle of operations.

- Idaho National Engineering Laboratory will have sufficient on-site disposal facility capacity through FY 2020 by employing waste minimization and other planned volume reduction initiatives.

- Los Alamos National Laboratory has sufficient volumetric capacity in current and planned disposal facilities through the projected life cycle of operations.

- Nevada Test Site has sufficient volumetric capacity in current and planned disposal facilities through the projected life cycle of operations.

- Oak Ridge Reservation currently does not have sufficient volumetric disposal capacity for the projected LLW volumes. Oak Ridge Reservation is investigating other waste management options and currently is waiting for approval to ship LLW to the Nevada Test Site.

- Rocky Flats Environmental Technology Site has planned sufficient volumetric disposal capacity to meet its on-site waste disposal projections.

- Savannah River Site has sufficient volumetric capacity in current and planned disposal facilities through the projected life cycle of operations.

LLW projections will evolve in response to changes in projection methodologies and/or disposition strategies. Projections of waste resulting from environmental restoration activities are particularly sensitive to factors such as land use assumptions, available technologies, and cleanup levels. As LLW projections are revised, disposal capacity plans will be revised accordingly.

Related Activities

The following efforts examining LLW and MLLW management strategies and configuration are underway and may impact the Department's current LLW and MLLW management strategies.

- In its implementation of the Federal Facility Compliance Act, the Department is evaluating MLLW disposal capacity.

- As part of the Defense Nuclear Facilities Safety Board's Recommendation 94-2, the Department is conducting the systems engineering evaluation and the all source terms analysis of its LLW management system.

- When finalized, the Department's Waste Management Programmatic Environmental Impact Statement will guide reconfiguration of the management of LLW, including expansion and/or construction of disposal facilities within the complex. The Record of Decision based on the Waste Management Programmatic Environmental Impact Statement and subsequent site-specific environmental impact statements will address the future disposal capacity needs within the complex. In addition, the Record of Decision will incorporate the results of the evaluation being conducted as part of the implementation of the Federal Facility Compliance Act, the systems engineering evaluation, and the all source term analysis.

The Environmental Management program also is currently preparing a Ten Year Plan to complete cleanup at most nuclear sites within a decade. The results of the Ten Year Plan may impact both the amount and rate of LLW to be generated in the future and the Department's management strategy for the waste. However, at this time such impacts are expected primarily to affect the timing of waste transfers to disposal, and any impacts relative to the type of disposal management to be selected are not yet known.

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1.0 Introduction

This report was prepared as part of the U.S. Department of Energy's response to the Defense Nuclear Facilities Safety Board's Recommendation 94-2, Conformance with Safety Standards at DOE Low-Level Nuclear Waste and Disposal Sites. The Defense Nuclear Facilities Safety Board's Recommendation 94-2 reviewed the current status of and expressed concerns with several aspects of the Department's LLW disposal practices. In response to the Defense Nuclear Facilities Safety Board's Recommendation 94-2, the Department implemented a number of actions, including the development of a uniform LLW projections program. A component of the projections program is The Current and Planned Low-Level Waste Disposal Capacity Report (abbreviated in this document as the "Report") prepared by the Waste Management and Environmental Restoration programs. Though the Defense Nuclear Facilities Safety Board's Recommendation 94-2 did not specifically discuss the disposal of MLLW, the Report includes volume projections for this waste type because its management often overlaps with LLW management.

Section 1.1 details the current status of the Department's LLW disposal configuration. Section 1.2 discusses the data sources for this Report and is organized by program. Sections 1.3 - 1.5 discuss the methodology used in developing the Report, list the definitions of terms used in this Report, and detail a number of assumptions supporting the projections data collected for this Report, respectively. Section 2.1 details the projections data and waste disposition strategy information collected from the Environmental Restoration, Nuclear Material and Facility Stabilization, and Waste Management programs. Section 2.1.1 begins with the universe of contaminated media and facilities addressed by the Environmental Restoration program and dispositions them, focusing on the projections of LLW and MLLW volumes. Nuclear material and facility stabilization projection data are presented in Section 2.1.2. Section 2.1.3 discusses projections from other activities in support of Department of Energy missions (e.g., those performed by Defense Programs, Energy Research, and Nuclear Energy (including the Naval Reactors program)). Section 2.2 discusses general treatment activities. Section 2.3 discusses disposal volumes for LLW and MLLW disposed at environmental restoration, commercial, and waste management disposal facilities. Section 3.0 compares the LLW projections against volumetric disposal capacity estimates to identify potential volumetric disposal capacity issues. Section 4.0 provides a summary of the data and analysis, and Section 5.0 identifies the conclusions that can be drawn from the analysis. Appendix A provides a brief description of the Department's planned and operational LLW disposal facilities.

Revision 0 of the Report focuses primarily on LLW and MLLW volume projections and volumetric disposal capacity. Revision 1, the planned revision of this Report scheduled for release in September 1997, will expand on the volumetric analysis by supplementing it with radiological disposal capacity data, reviewing facility radiological performance, and evaluating its adequacy relative to the disposal requirements. Revision 1 will be based on methodologies developed from and data collected based on the LLW projections guidance document (scheduled for release in December 1996). The LLW projections guidance document is being prepared to improve the accuracy and consistency of LLW projections by establishing a consistent and reliable methodology for acquiring and using LLW data. The guidance document also will outline a uniform program for developing and maintaining LLW projections throughout the Department.

1.1 History and Current Status of the Department's LLW Disposal Configuration

Initially, the Department's predecessor, the Atomic Energy Commission, operated the only disposal facilities for both commercial and defense program LLW. When commercial LLW disposal facilities began to operate, the Atomic Energy Commission shipped LLW to these facilities mainly to provide them with economic scale. After the closure of several commercial disposal facilities in 1979, the Department directed all its sites to dispose of LLW within the Department of Energy complex. Department of Energy sites unable to dispose of their waste in on-site disposal facilities negotiated with other Department of Energy field offices and arranged to ship LLW to other Department of Energy sites. In 1979, the Department issued a formal policy directive requiring all Department of Energy field offices and the Naval Reactors program to stop disposing of LLW at commercial facilities ("Redirection of DOE Contractor Waste Formerly Sent to Commercial Burial Sites," November 19, 1979, U.S. Department of Energy). The policy directive also required the Naval Reactors program specifically to redirect LLW shipments to Savannah River Site and that wastes generated at non-defense facilities not be sent to Sandia National Laboratory, Los Alamos National Laboratory, Savannah River Site, Oak Ridge Y-12 Plant, Pantex Plant, or Nevada Test Site. These initial programmatic and mission considerations, rather than facility-specific performance factors were the primary influences on the current waste management configuration. Nevada Test Site and Los Alamos National Laboratory were chosen for disposal of all Department of Energy defense-generated waste because of their historical defense program affiliation. Because of its reactor testing and other nuclear research missions, Idaho National Engineering Laboratory was selected as the disposal site for research-generated LLW. Hanford Site was chosen as an alternate disposal site to Idaho National Engineering Laboratory. Savannah River Site was chosen to receive Naval Reactors program LLW and non-tritium-contaminated LLW generated at Mound Plant. Over time, increasingly strict disposal site waste acceptance criteria and State involvement required a number of facilities (Idaho National Engineering Laboratory, Los Alamos National Laboratory, and Oak Ridge Reservation) to stop accepting or consider not accepting off-site LLW for disposal. Table 1.1 lists the Department of Energy sites that currently accept off-site LLW for disposal and off-site waste generators. Figure 1.1 details the Department's LLW disposal configuration.

Currently, the Department disposes of LLW and/or MLLW at six sites: Hanford Site, Idaho National Engineering Laboratory, Los Alamos National Laboratory, Nevada Test Site, Oak Ridge Reservation, and Savannah River Site. Only Hanford Site, Nevada Test Site, and Savannah River Site accept off-site LLW for disposal. Over the last six years, approximately 50,000 m^3 of LLW was disposed annually at disposal facilities located at the six sites. Each site has established its own infrastructure and management structure to meet site-specific disposal requirements. Department of Energy sites also ship low activity LLW and MLLW to commercial disposal facilities (the Department currently transfers waste to the Envirocare commercial disposal facility in Utah; other commercial disposal facilities will be considered as they become available). The Department plans to operate three additional facilities at Fernald Environmental Management Project, Hanford Site, and Rocky Flats Environmental Technology Site that will solely accept on-site remediation waste.

The combined current and planned available LLW disposal capacity of Waste Management program-operated facilities is approximately 5.7 million m^3. The combined current and planned

LLW disposal capacity for the three Environmental Restoration program-operated disposal facilities is approximately 5.8 million m^3. Appendix A summarizes design and capacity data of the Department's LLW disposal facilities. Historical annual disposal volumes for the various facilities at the six sites are well documented. Table 1.2 summarizes these historical volumes to provide a benchmark for future disposal requirements.

Table 1.1: Department of Energy Off-Site Waste Generators and Disposal Sites

Disposal Site	Off-site Waste Generator	
Savannah River Site	Bettis Atomic Power Laboratory, PA Knolls Atomic Power Laboratory, NY Newport News Shipbuilding, VA	Norfolk Naval Shipyard, VA Pinellas Plant, FL Portsmouth Naval Shipyard, ME
Nevada Test Site[1]	Aberdeen Proving Ground, MD Army Industrial Operations Command Defense Nuclear Agency Energy Technology Engineering Center, CA Fernald Environmental Management Project, OH General Atomics, CA Grand Junction Projects Office, CO Inhalation Toxicology Research Institute, NM Kansas City Plant, MO	Lawrence Livermore National Laboratory, CA Mound Plant, OH Oak Ridge Reservation, TN Pantex Plant, TX Pinellas Plant, FL Reactive Metals, Inc., OH Rocky Flats Environmental Technology Site, CO Sandia National Laboratories, CA Sandia National Laboratories, NM
Hanford Site[2]	Ames Laboratory, IA Argonne National Laboratory-East, IL (Includes New Brunswick Lab- Illinois) Battelle Columbus Laboratory, OH Bettis Atomic Power Laboratory, PA Brookhaven National Laboratory, NY Environmental Measurements Laboratory, NY Energy Technology Engineering Center, CA Fermi National Accelerator Laboratory, IL General Atomics, CA Knolls Atomic Power Laboratory, NY Lawrence Berkeley Laboratory, CA Laboratory for Energy Related Health Research, CA	Massachusetts Institute of Technology, MA Mare Island Naval Shipyard, CA Martin Marrieta Energy Systems Paducah Gaseous Diffusion Plant, KY Pearl Harbor Naval Shipyard, HI Pittsburgh Energy Technology Center, PA Portsmouth Gaseous Diffusion Plant, OH Princeton Plasma Physics Laboratory, NJ Puget Sound Naval Shipyard, WA Renssalear Polytechnic, NY Rocketdyne Canoga Park, CA Rocky Flats Environmental Technology Site, CO Stanford Linear Accelerator Center, CA

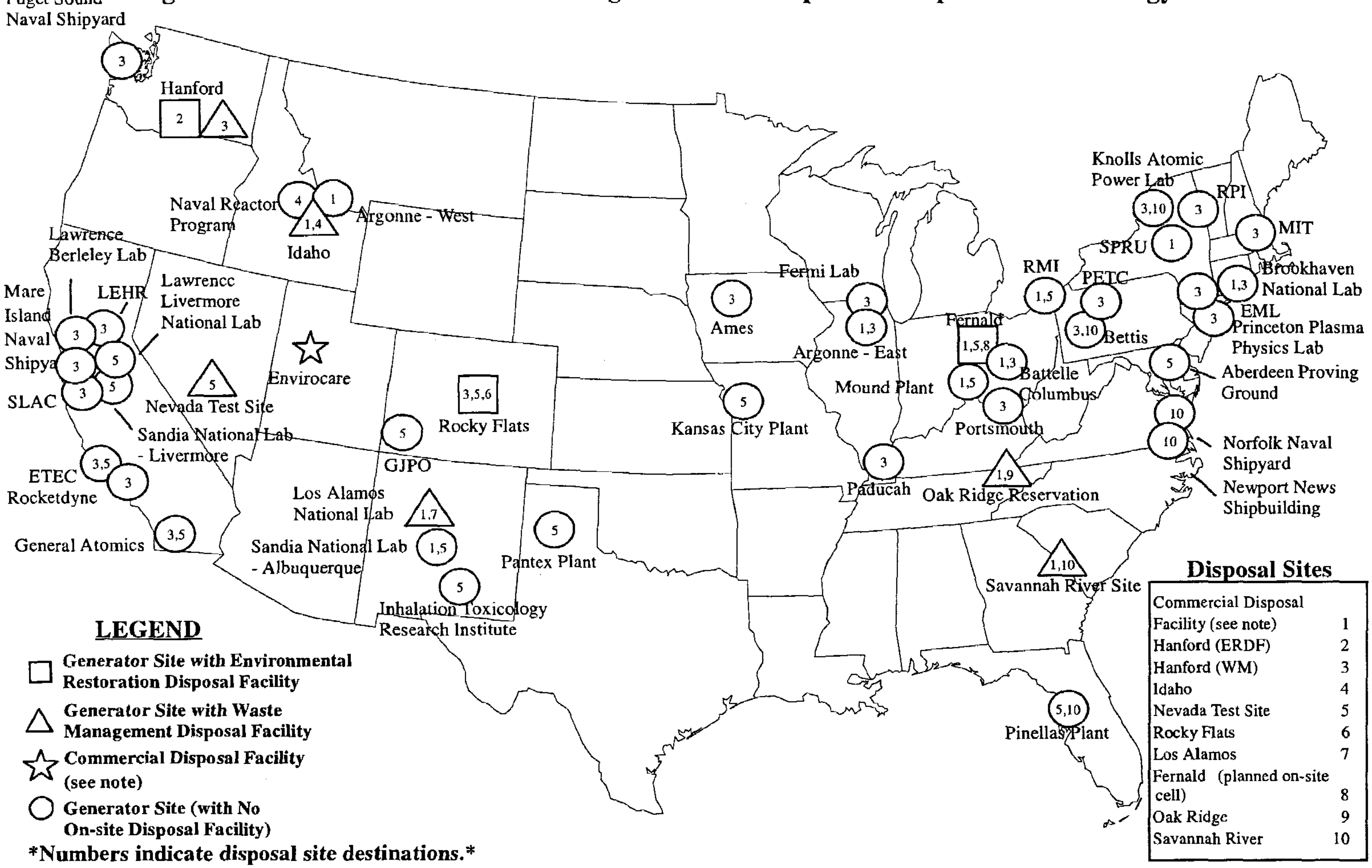
1 Sites with completed applications to ship waste to the Nevada Test Site. Additional facilities that have applications in progress, and some facilities which are approved by the Department to ship to the Nevada Test Site but which have not submitted an application, are not included in the list.

2 Some listed sites have not sent waste to date; these sites are approved generators, however, planning to send waste to the Hanford Site.

NOTE: As Formerly Utilized Sites Remedial Action Program generators have preliminary disposal plans only, these sites have not been included.

Data Source: Personal communication with Rob Campbell (DOE Office of Environmental Management), September 1995

Figure 1.1: Current and Planned Configuration for Disposal of Department of Energy LLW



NOTE: As Formerly Utilized Sites Remedial Action Program generators have preliminary disposal plans only, these sites have not been included.
The Department currently disposes of waste at the Envirocare commercial disposal facility in Utah; other commercial facilities will be considered as they become available.

Table 1.2: Historical LLW Disposal Volumes (in thousands of m^3)

Year	Hanford Site	Nevada Test Site	Los Alamos National Laboratory	Idaho National Engineering Laboratory	Oak Ridge Reservation[1]	Savannah River Site	Total
Pre-1986	482.7	215.8	186.5	132.5	301.9	471	1790.4
1986	21.2	25.9	4.5	3.4	16.8	30.1	101.9
1987	202.3	81.1	3.7	3.0	16.7	28.2	335
1988	16.8	30.8	4.3	2.0	11.2	30.2	95.3
1989	13.7	29.3	6.4	1.3	7.0	26.8	84.5
1990	13.4	16.7	4.5	1.8	4.7	26.6	60.1
1991	10.6	9.6	5.8	1.3	0.5	23.8	51.6
1992	10.9	24.5	2.3	0.8	1.1	13.0	48.2
1993	12.1	18.6	2.7	0.9	0.9	15.3	50.5
1994	13.7	22.9	1.9	1.9	0.4	11.4	52.2
1995	13.9	25.0	3.1	0.9	0.4	5.1	48.4
Total	**811.3**	**500.2**	**225.7**	**149.8**	**361.6**	**681.5**	**2,730.1**

1 LLW land disposal at Oak Ridge Reservation includes both Oak Ridge National Laboratory and Oak Ridge Y-12 Plant. Land disposal of LLW at Oak Ridge Y-12 Plant ceased July 1, 1991.

Data Source: IDB Report - 1994, Rev. 11, September 1995; 1995 data obtained during teleconference with J. Hwang (April 1996)

1.1.1 Waste Management Programmatic Environmental Impact Statement

A Waste Management Programmatic Environmental Impact Statement has been drafted to evaluate various future LLW and MLLW waste management configurations. The Department plans to use the analysis in the Waste Management Programmatic Environmental Impact Statement, together with other analyses that result from the implementation of Defense Nuclear Facilities Safety Board's Recommendation 94-2, to develop a Record of Decision documenting the Department's future complex-wide LLW management configuration. When finalized, the Department's Waste Management Programmatic Environmental Impact Statement will guide reconfiguration of the management of LLW, including expansion and/or construction of disposal facilities within the complex. The Record of Decision based on the Waste Management Programmatic Environmental Impact Statement and subsequent site-specific environmental impact statements will address the future disposal capacity needs within the complex. The Waste Management Programmatic Environmental Impact Statement considers 14 different configurations for the management of LLW and seven different configurations for the management of MLLW. It also evaluates disposal alternatives for both LLW and MLLW and considers both existing and new disposal facilities. The 14 alternatives for managing of LLW in the Waste

Management Programmatic Environmental Impact Statement are divided into four categories: No-Action, Decentralized, Regionalized, and Centralized.

A. *No-Action:* This alternative is the base case for LLW management and accounts only for the current treatment and disposal configuration. Currently, six sites dispose of LLW; only Hanford Site, Nevada Test Site, and Savannah River Site accept off-site LLW.

B. *Decentralized:* This alternative evaluates some treatment capacity at all generator sites and disposal activities at 16 Department of Energy sites. The construction of new storage and disposal facilities at 10 sites would be required by this alternative.

C. *Regionalized:* Seven variants of this alternative, each with differing numbers of sites conducting treatment and/or disposal, are summarized below:

	Number of Treatment Sites	Number of Disposal Sites
- Regionalized One	11 sites (minimal treatment)	12 sites
- Regionalized Two	11 sites (minimal treatment)	12 sites
(All sites but Nevada Test Site treat with volume reduction technologies)		

Regionalized Alternatives Three through Seven focus on eight Department of Energy sites: Hanford Site, Idaho National Engineering Laboratory, Los Alamos National Laboratory, Nevada Test Site, Oak Ridge Reservation, Portsmouth Gaseous Diffusion Plant, Rocky Flats Environmental Technology Site, and Savannah River Site.

	Number of Treatment Sites	Disposal Site
- Regionalized Three	All generators (minimal treatment)	6 sites
- Regionalized Four	8 sites	6 sites
(All sites but Nevada Test Site treat with volume reduction technologies)		
- Regionalized Five	4 sites (volume reduction)	6 sites
- Regionalized Six	8 sites (minimal treatment)	2 sites
- Regionalized Seven	All generators (minimal treatment)	2 sites

D. *Centralized:* Five variants of the Centralized Alternative considered in the Waste Management Programmatic Environmental Impact Statement are summarized below:

	Number of Treatment Sites	Disposal Site
- Centralized One	All generators (minimal treatment)	Hanford Site
- Centralized Two	All generators (minimal treatment)	Nevada Test Site
- Centralized Three	7 sites (volume reduction)	Hanford Site

-	Centralized Four	7 sites (volume reduction)	Nevada Test Site
-	Centralized Five	Hanford Site treats all LLW with volume reduction technologies.	Hanford Site

Only the Decentralized, Regionalized One, and Regionalized Two Alternatives consider disposal activities at facilities that currently do not dispose of LLW on-site.

The Waste Management Programmatic Environmental Impact Statement reviewed seven alternatives for MLLW management in four broad categories: No-action, Decentralized, Regionalized, and Centralized.

A. *No-Action:* This alternative for MLLW analyzed treatment at existing facilities where the Resource Conservation and Recovery Act Land Disposal Requirements can be attained, and indefinite long-term storage of MLLW. This alternative would not comply with the Resource Conservation and Recovery Act Land Disposal Requirement prohibition on storage of waste.

B. *Decentralized:* This alternative evaluated treatment of MLLW to Land Disposal Requirements at 37 sites and disposal at 16 sites.

C. *Regionalized:* Four variants of the Regionalized alternative are summarized below:

		Number of Treatment Sites	Number of Disposal Sites
-	Regionalized One	11 sites	12 sites
-	Regionalized Two	7 sites	6 sites
-	Regionalized Three	7 sites	1 site
-	Regionalized Four	4 sites	6 sites

D. *Centralized:* This alternative consolidates all treatment and disposal activities for MLLW at Hanford Site.

The findings and conclusions from this Report will be considered in the development of the LLW Record of Decision of the Waste Management Programmatic Environmental Impact Statement. The Waste Management Programmatic Environmental Impact Statement is scheduled to be finalized by the end of 1996.

1.2 Data Sources

The data presented in this Report were obtained from a number of sources. Table 1.3 summarizes the data sources for the Report by organization and by type of data. The field personnel submitting data were principally responsible for data quality review, as required by Department of Energy Order 5700.6C, Quality Assurance. Headquarters staff also conducted reviews.

Table 1.3: Data Calls Used to Compile Report*

Data Source	Waste Generation Data	Disposal Capacity Data
Nuclear Material and Facility Stabilization	- Office of Strategic Planning and Analysis Baseline Environmental Management Report Data Set (April 1996)	- Not Applicable
Environmental Restoration	- Draft Environmental Restoration Core Database (February 1996)	- Conceptual Design Reports - Record of Decision Documents
Waste Management	- Integrated Data Base Report - 1994, Rev. 11, September 1995 - 1995 Mixed Waste Inventory Report - 1996 Waste Management Baseline Environmental Management Report Database	- Integrated Data Base Report - 1994, Rev. 11, September 1995 - Preliminary Radiological Performance Assessments

* Specific references are provided for waste generation and disposal capacity data as applicable.

1.2.1 Nuclear Material and Facility Stabilization

As part of its submittal to the 1996 Baseline Environmental Management Report, the Nuclear Material and Facility Stabilization program has developed projections of its life cycle generation of LLW and MLLW volumes. In order to determine the type of deactivation and stabilization activities required, the Nuclear Material and Facility Stabilization program coordinated with other Department of Energy programs to determine when and which facilities would be declared surplus, and considered future site missions and cleanup requirements in developing its estimates.

1.2.2 Environmental Restoration

The Environmental Restoration program handles waste volumes from three sources: inventories of stored waste volumes from previous operations awaiting treatment and disposal, waste generated through remediation activities, and waste generated from decommissioning of surplus contaminated facilities. The Environmental Restoration Core Database is the exclusive source of environmental restoration projections data. The Core Database is the repository of environmental restoration cost and technical scope information. This database is organized by site, environmental restoration operational unit, and by discrete "elements" within that operational unit. These elements may comprise stored waste, contaminated media, or contaminated facilities. For example, a site may have packaged LLW (stored waste) awaiting shipment to an off-site disposal facility, soils potentially contaminated with radionuclides (contaminated media), or a surplus contaminated facility undergoing decommissioning. The Environmental Restoration program may address these elements with one or several remediation strategies, ranging from in-situ treatment to transfer of waste to the Waste Management program for treatment and disposal. Depending on the chosen strategy, the remediation of the contaminated soil or the decommissioning activity may generate a waste stream requiring treatment and disposal. Each environmental restoration site submitted data documenting the following for each of these discrete elements:

- type of media (e.g., soil, metal debris, wastewater);
- characterization information (radioactive and/or hazardous contaminants);
- volumes of contaminated media;
- anticipated remediation strategy (e.g., disposal of generated LLW);
- projected volumes of waste generated by that remediation strategy;
- schedule of waste generation by that remediation strategy; and
- management of generated waste.

This Report utilized data from the draft Environmental Restoration Core Database. The Core Database will be updated regularly; extensive work already has begun to update these data.

1.2.3 Waste Management

Waste management projections data primarily were obtained from the following three sources:

- Integrated Data Base Report - 1994, Rev. 11, September 1995;
- 1996 Waste Management Baseline Environmental Management Report Database; and
- 1995 Mixed Waste Inventory Report.

The data presented in these data sets are organized by site and by waste physical forms. Waste physical forms describe the physical characteristics of LLW and can vary from debris material, contaminated or activated metals/equipment or hardware, to liquids or gases. The detailed waste physical forms allow the Waste Management program to develop better capacity and management plans for its management alternatives and final disposition. Waste physical forms used in the Integrated Data Base Report are based on Nuclear Regulatory Commission manifest requirements with modifications to properly describe Department of Energy LLW. The physical forms used in the Waste Management Baseline Environmental Management Report Database are based on Resource Conservation and Recovery Act requirements and focus on the treatability of hazardous components.

In responding to the three data calls, Department of Energy sites provided the following data:

- current inventory (legacy) of each waste physical form;
- projection for future generation of LLW;
- radiological data for each waste physical form;
- status of currently stored waste;
- on-site treatment, storage, and disposal facilities and their capacities; and
- shipment information to off-site treatment, storage, and disposal facilities.

The Integrated Data Base Report was the primary source of waste management data. The Integrated Data Base Report projected waste generation volumes to the year 2030. The Waste Management Baseline Environmental Management Report Database was used for sites for which no data were available in the Integrated Data Base Report. In addition, the Waste Management Baseline Environmental Management Report Database was used for waste generation volumes for the years 2031 to 2070 (the Baseline Environmental Management Report's defined end date for the Department's

Environmental Management program) to provide a life cycle waste profile of projections. Table 1.4 summarizes how these two databases and the Mixed Waste Inventory Report were used in this section.

Table 1.4: Sources of Waste Management Data

	Inventory in 1995	Year 1996 - 2000	Year 2001 - 2030	Year 2031 - 2070
Integrated Data Base Report	Primary Source (LLW)	Primary Source (LLW)	Primary Source (LLW)	--
Mixed Waste Inventory Report	Primary Source (MLLW)	Primary Source (MLLW)	--	--
Waste Management Baseline Environmental Management Report Database	Secondary Source (LLW and MLLW)	Secondary Source (LLW and MLLW)	Sole Source (MLLW)	Sole Source (LLW and MLLW)

1.3 Methodology

The following methodology was used in developing the analysis in this Report:

- Examine available data sources and review their general utility and limitations.

- Collect current projection data for LLW and MLLW. The projection data benefited significantly from the scheduling and integration exercises conducted both within sites and across the Department of Energy complex for the purposes of the Baseline Environmental Management Report.

- Develop data as needed to determine the disposition of waste volumes. For example, where sites did not provide information about how waste projections would be managed, the analysis in this Report supplemented available information on the current LLW disposal configuration.

- Combine projections from various Department of Energy programs to determine flows of waste to Waste Management program-operated disposal facilities, Environmental Restoration program-operated disposal facilities, and commercially operated disposal facilities.

- Collect data on available volumetric disposal capacity and descriptions of disposal facilities. Data were collected from preliminary Performance Assessments, Records of Decision, and other documents. Data also were obtained from field personnel.

- Compile available volumetric disposal capacity data and compare against the projected LLW volumes as a preliminary evaluation of adequacy.

The resulting analysis from this methodology provides a macroscopic view of the Department's LLW management program and highlights major trends, such as the reliance on Comprehensive Environmental Response, Compensation, and Liability Act-permitted disposal cells and the role of commercial disposal facilities. It also provides a general sense of the adequacy of current and planned disposal capacity relative to projected disposal requirements.

1.4 Definitions

The following definitions are used in this Report:

Contaminated Media: The Environmental Restoration program will address millions of cubic meters of soils, sediments, sludges, debris, and water potentially contaminated with radionuclides and hazardous constituents. This Report does not consider contaminated media as LLW or MLLW when the media are addressed through in-situ containment or treatment remediation strategies. LLW or MLLW are generated when remediation strategies generate excavated or removed materials that require disposal in specially engineered disposal facilities.

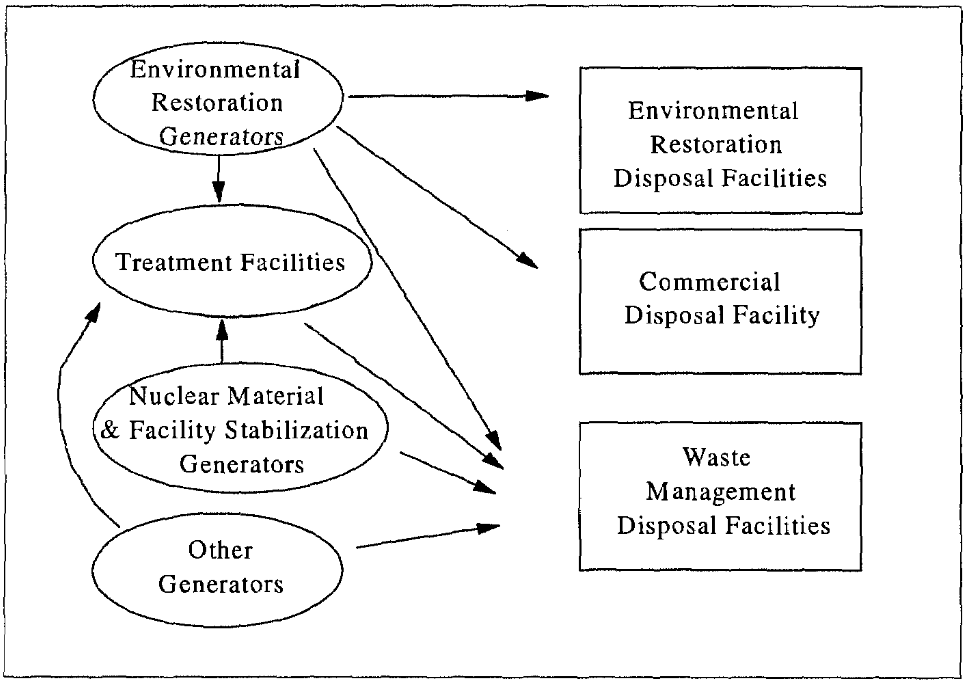
Deactivation: The deactivation process places a facility in a safe and stable condition that minimizes the long-term cost of a surveillance and maintenance program and is protective of workers, the public, and the environment until decommissioning is complete. Actions include the removal of fuel, draining and/or de-energizing of nonessential systems, removal of stored radioactive and hazardous materials, and related actions. Source: "DOE D&D Resource Manual" (DOE/EM-0246)

Decommissioning: Decommissioning takes place after deactivation and includes surveillance and maintenance, decontamination, and/or dismantlement. These actions are taken at the end of the life of a facility to retire it from service with adequate regard for the health and safety of workers and the public and protection of the environment. The ultimate goal of decommissioning is unrestricted release or restricted use of the site. Source: "DOE D&D Resource Manual" (DOE/EM-0246)

Disposal Facilities: Department of Energy Order 5820.2A defines a disposal facility as the land, structures, and equipment used for disposal of waste. A disposal site is that portion of a disposal facility which is used to dispose of waste. For LLW, it consists of a disposal unit and a buffer zone. A disposal unit is the discrete portion (e.g., a pit, trench, tumulus, vault, or bunker) of the disposal site into which waste is placed for disposal. Source: DOE Order 5820.2A. The Department has stipulated that waste management disposal facilities at only three sites (Hanford Site, Savannah River Site, and Nevada Test Site) accept waste from off-site generators. Environmental Restoration program-operated disposal facilities are designed and constructed to manage LLW/MLLW generated by on-site remediation activities only.

Disposal Ready Volume Projections: LLW and MLLW are generated by a number of Department of Energy programs and disposed by Environmental Restoration program-operated and Waste Management program-operated facilities, as well as commercial facilities. LLW and MLLW volume projections vary depending on the point in time at which they were reported. Figure 1.2 provides a conceptual outline of the flow of LLW and MLLW between the various Department of Energy programs. Projection data are available for a number of different volumes, from initial LLW generated from a remediation response to contaminated media to volumes transferred for treatment to volumes transferred for disposal. In general, data on treatment were not available. The projections reported in this Report represent the waste volumes requiring disposal in engineered facilities. Volume projections transferred by any generator to the Waste Management program for treatment and/or disposal represent the volumes at the time of transfer to the Waste Management program. As certain types of treatment, such as compaction or incineration, may significantly reduce volumes for final disposal, these volumetric projections may overstate required disposal capacities. Moreover, employing aggressive waste minimization techniques should further reduce the volume projections.

Figure 1.2: Department of Energy Waste Flows



Low-Level Waste: Department of Energy Order 5820.2A defines low-level waste as waste that contains radioactivity and is not classified as high-level waste, transuranic waste, or spent nuclear fuel or 11e(2) byproduct material as defined by Department of Energy Order 5820.2A. Test specimens of fissionable material irradiated only for research and development, and not for the production of power or plutonium, may be classified as low-level waste, provided the concentration of transuranic is less than 100 nanocuries per gram.

Mixed Low-Level Waste: Department of Energy Order 5820.2A defines mixed low-level waste as waste containing both radioactive and hazardous components as defined by the Atomic Energy Act and the Resource Conservation and Recovery Act, respectively.

1.5 Assumptions

The assumptions for the projections are a function of the various databases used for this Report and bound the scope of this analysis. These assumptions are detailed below:

- The current scope (as defined by the site submittals made to the 1996 Baseline Environmental Management Report) of the Department's cleanup program does not significantly change;

- Federal environmental regulations (e.g., the Comprehensive Environmental Response, Compensation, and Liability Act) do not change in a manner that would increase or decrease cleanup volumes (e.g., a *de minimis* standard is established that would significantly affect waste generation projections);

- Funding levels for the environmental cleanup program are held constant. No significant reprioritization of cleanup (e.g., accelerating stabilization) occurs;

- Land use designations assumed by site personnel projecting LLW and MLLW volumes and schedules do not change;

- Current technologies are employed in cleanup activities;

- Byproduct material as defined by Section 11e(2) of the Atomic Energy Act, as amended, is not considered in this Report.

- The current configuration of LLW management--treatment, storage, and disposal--will continue until program completion;

- All newly generated waste will be disposed in the year of generation, and treatment does not alter the volume of waste requiring disposal;

- The current mission for generators will remain unchanged until program completion;

- No pre-1988 buried LLW will be retrieved nor will LLW in closed LLW disposal facilities be retrieved;

- Neither the United States Enrichment Corporation nor any other Nuclear Regulatory Commission licensed uranium enrichment facility will request that the Department dispose of their LLW pursuant to Public Law 104-134, Title III, Chapter 1, Subchapter A, Section 3113;

- The Waste Management program is responsible for managing LLW and MLLW generated by other generators, such as Defense Programs, Energy Research, and Nuclear Energy (including the Naval Reactors program);

- The Nuclear Material and Facility Stabilization program will not operate LLW or MLLW disposal facilities;

- LLW and MLLW volumes generated in the deactivation of surplus contaminated facilities will be transferred to the Waste Management program for treatment and eventual disposal;

- The Environmental Restoration program will decommission facilities; and

- Facilities currently in the inventory of the Nuclear Material and Facility Stabilization program, as well as facilities forecasted to be surplus before FY 1999 in the Surplus Facility Inventory Assessment, comprise all facilities that will require stabilization and deactivation.

2.0 Projections

Section 2.1 details LLW and MLLW projections from the cleanup of contaminated media and facilities, as well as by deactivation and stabilization of contaminated facilities. In addition, Section 2.1 includes LLW and MLLW projections by other generators (e.g., Defense Programs, Energy Research, and Nuclear Energy (including the Naval Reactors program)) and legacy LLW and MLLW currently in storage. Section 2.2 provides a brief overview of treatment strategies. Section 2.3 details specific disposal-ready volume projections for Environmental Restoration program-operated disposal facilities, commercial disposal facilities (the Department currently transfers waste to the Envirocare facility in Utah; other commercial disposal facilities will be considered as they become available), and Waste Management program-operated disposal facilities.

2.1 LLW and MLLW Generation Projections

Section 2.1.1 details the initial volume of contaminated media within the scope of the Environmental Restoration program and provides an overview of how the large fraction of these contaminated media and facilities will be addressed through in-situ remediation strategies. Section 2.1.2 details nuclear material and facility stabilization projections of generated LLW and MLLW from stabilization and deactivation of facilities within the Department of Energy complex that have been declared surplus. Section 2.1.3 details projections of LLW and MLLW generated by other generators (e.g., Defense Programs, Energy Research, and Nuclear Energy (including the Naval Reactors program)). Finally, Section 2.1.4 details existing stored inventories of legacy LLW and MLLW.

2.1.1 Environmental Restoration Contaminated Media, LLW, and MLLW Projections

2.1.1.1 Initial Volume of Contaminated Media and Facilities

Across the complex, the Environmental Restoration program reported a total of 43 million m^3 of media and facilities contaminated with radionuclides. The Environmental Restoration program also reported a total of 13 million m^3 of media and facilities contaminated with both radionuclides and hazardous contaminants. Both of these volumes of contaminated media and facilities represent only non-aqueous media, i.e., they exclude contaminated groundwater and surface water. Over 93 percent of the initial non-aqueous volume of radionuclide-contaminated media or surplus facilities was reported by six sites (see Table 2.1 and Figure 2.1).

The majority--approximately 56 percent--of reported volumes of radionuclide-contaminated media and facilities is soil/debris (24 million m^3). In addition, soil (14 million m^3) and metal debris (2.3 million m^3) are other common matrices.

Table 2.1: Environmental Restoration Projections of Media and Facilities with Radionuclide Contaminants

Site	Total Volume
Hanford Site	24,000,000 m^3
Los Alamos National Laboratory	9,100,000 m^3
Savannah River Site	2,400,000 m^3
Fernald Environmental Management Project	2,300,000 m^3
Oak Ridge Reservation	1,100,000 m^3
Nevada Test Site	1,100,000 m^3

Over 94 percent of the non-aqueous volume of media or surplus facilities with both radionuclides and hazardous contaminants was reported by five sites (see Table 2.2 and Figure 2.2).

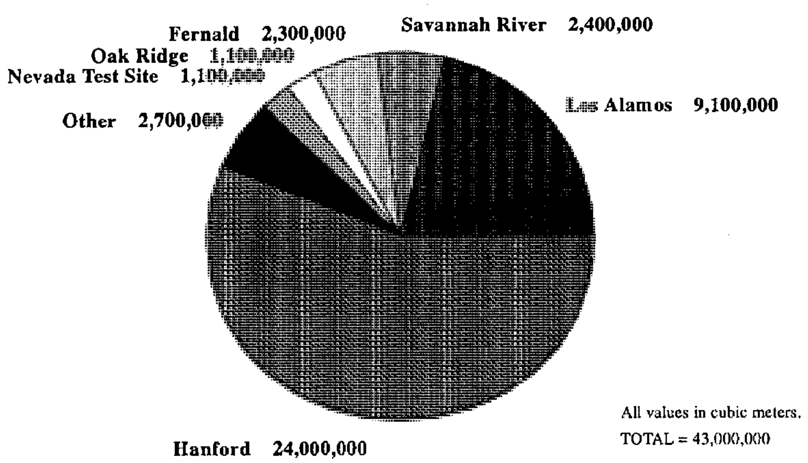
Table 2.2: Environmental Restoration Projections of Media and Facilities with Radionuclide and Hazardous Contaminants

Site	Total Volume
Savannah River Site	11,000,000 m^3
Los Alamos National Laboratory	500,000 m^3
Paducah Gaseous Diffusion Plant	460,000 m^3
Oak Ridge Reservation	460,000 m^3
Rocky Flats Environmental Technology Site	380,000 m^3

Most of the reported non-aqueous media volumes contaminated with both radionuclides and hazardous constituents consist of soil (12 million m^3) or inorganic nonmetal debris (0.9 million m^3).

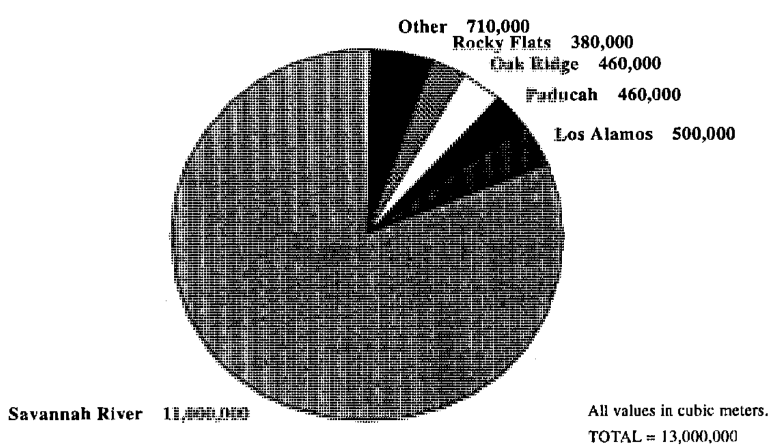
These estimates reflect the current understanding of environmental restoration contaminated media and facilities. These volumes may increase or decrease in the future as site characterization of contaminated media plumes better defines the extent and concentration of contamination. In addition, activities are currently underway to review field-submitted data (regarding missing data elements and inconsistent use of certain fields by sites) in the Environmental Restoration Core Database. The result of these reviews may modify the reported data. Finally, contaminated media volumes may increase should remediation of certain contaminated areas, currently determined as infeasible (whether for technological, economic, or collateral environmental damage factors), become feasible. These areas, such as the contamination caused by underground testing activities at Nevada Test Site, are currently being addressed by the Environmental Restoration program through monitoring and access control. Table 2.3 provides examples of known contaminated areas for which no volumes are given in this Report.

Figure 2.1: Environmental Restoration Non-Aqueous Media and Facilities Contaminated with Radionuclides



Data Source: Draft Environmental Restoration Core Database (February 1996)

Figure 2.2: Environmental Restoration Non-Aqueous Media and Facilities Contaminated with Radionuclides and Hazardous Contaminants



Data Source: Draft Environmental Restoration Core Database (February 1996)

Table 2.3: Examples of Contaminated Areas Not Addressed in this Report

Site	Area
Savannah River Site	Par Pond
	L Lake
Oak Ridge Reservation	Clinch River
	Watts Bar Reservoir
	Hydrofracture Facility
Nevada Test Site	Plutonium Soils*
	Underground Test Area

* Nevada Test Site projected generating approximately 1.0 million m^3 of LLW from the Plutonium Soils area. This projection is included in this Report. However, please note that initial estimates of the Plutonium Soils area stated that there were approximately 14 million m^3 of soils contaminated with radionuclides. The 1.0 million m^3 estimate provided in this Report may indicate that the remainder of the contaminated media may not generate additional LLW for disposal in engineered facilities.

Data Source: Draft Environmental Restoration Core Database (February 1996)

In contrast, some sites may have provided overly conservative (i.e., large) estimates of contaminated media volumes. For example, Savannah River Site estimated very large volumes of potentially contaminated material at Waste Area Group 7, specifically 6.4 million m^3 of soils potentially contaminated with radionuclides and hazardous contaminants.

2.1.1.2 Contaminated Groundwater and Surface Water Volumes

The Environmental Restoration program reported 4.0 million m^3 of groundwater and surface water contaminated with radionuclides and 110 million m^3 of groundwater and surface water contaminated with radionuclides and hazardous contaminants. These volumes most likely underrepresent the total volume of contaminated groundwater and surface water. In general, most of these volumes simply will be monitored with access controls until natural attenuation reduces contaminant concentrations to acceptable levels. Some of the contaminated groundwaters and surface waters will be managed with pump and treat systems. No estimates are currently available for the LLW and MLLW volumes generated (e.g., filter media and extracted contaminants) by the treatment of the contaminated groundwater and surface water. At many sites, the generated volumes of LLW and MLLW would be transferred to the Waste Management program for treatment and disposal.

2.1.1.3 Determining Final Disposition

The Environmental Restoration program reported anticipated remediation strategies to address contaminated media, facilities, and any stored waste. The Environmental Restoration program works with State and Federal regulators under the Resource Conservation and Recovery Act, the Comprehensive Environmental Response, Compensation, and Liability Act, and other State and Federal regulations to determine the appropriate remediation response, which may range from no further response to removal of all contaminated media for disposal in a specially engineered facility. Remediation strategies were chosen based on an evaluation of numerous variables ranging from eventual land use envisioned for that site, to site-specific hydrological, meteorological, or geological conditions, to stakeholder input.

The Environmental Restoration program generally provided information on the final disposition of contaminated media rather than intermediate responses such as treatment and storage. For example, a site may have provided data on the anticipated remediation strategy addressing radioactive rubble from decommissioned facilities as transfer to the Waste Management program for disposal. Though the remediation activity is described as "transfer to the Waste Management program for disposal," the Environmental Restoration program's anticipated remediation strategy may include some degree of pretreatment, interim storage, and packaging.

The Environmental Restoration program reported initial volumes and then assigned response strategies to each discrete element. Often the distinguishing characteristic among separate elements within an operable unit is the type of anticipated remediation strategy required to manage them. For example, one area of contaminated soil may be divided into two elements. A small volume of soil with a relatively high degree of radioactive contamination may be managed by removal to a specially engineered disposal facility, while the large remaining volumes of soil with a relatively low degree of radioactive contamination may be managed by in-situ capping. Figure 2.3 outlines the general remediation strategies that the Environmental Restoration program utilizes.

Figure 2.3: Anticipated Environmental Restoration Remediation Strategies Addressing Contaminated Media/Facilities

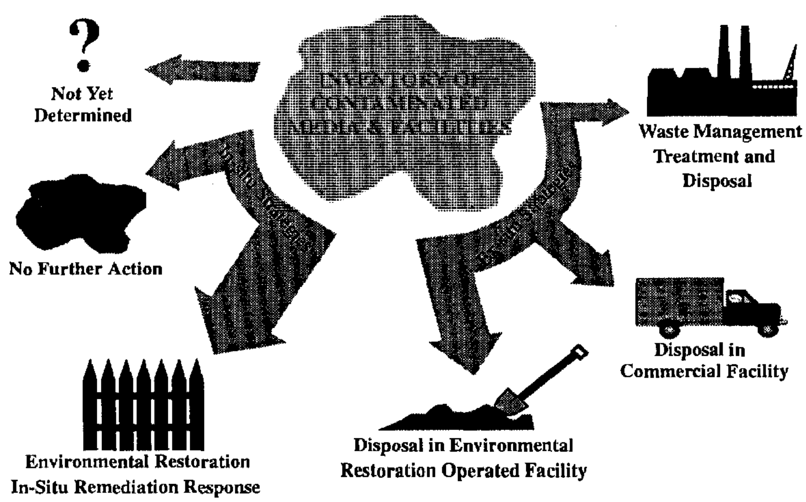
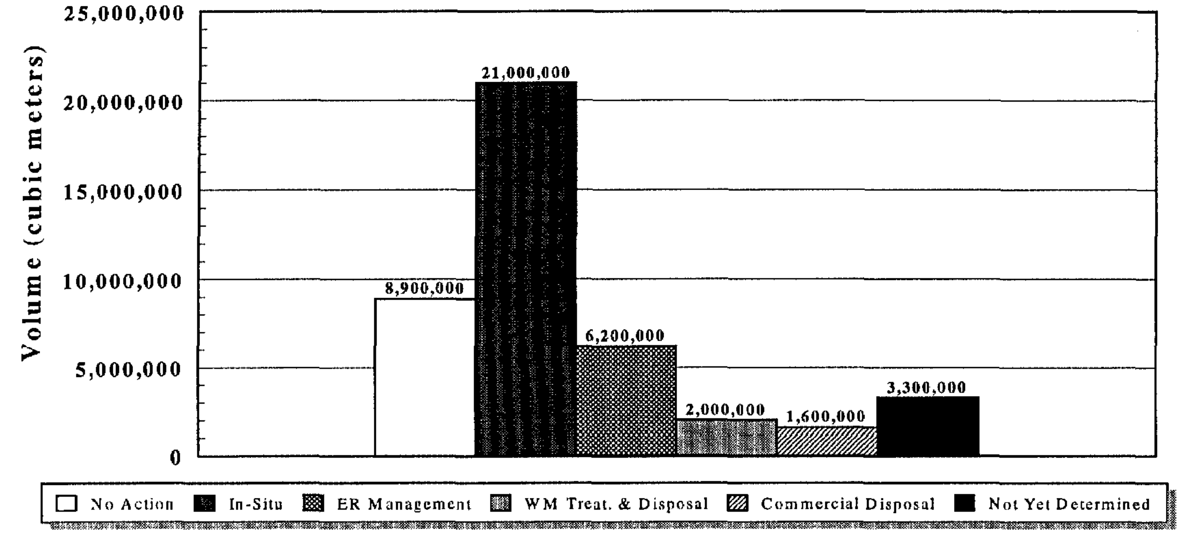
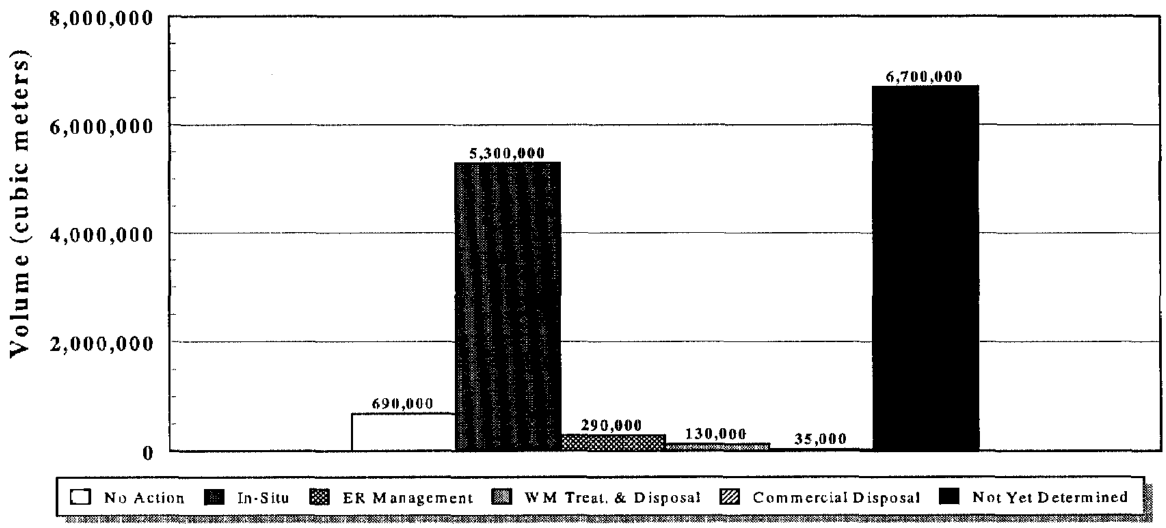


Figure 2.4: Environmental Restoration Remediation Strategies for Media and Facilities Contaminated with Radionuclides



NOTE: Non-aqueous media only. All values in cubic meters. TOTAL = 43,000,000
Data Source: Draft Environmental Restoration Core Database (February 1996)

Figure 2.5: Environmental Restoration Remediation Strategies for Media and Facilities Contaminated with Radionuclides and Hazardous Contaminants



NOTE: Non-aqueous media only. All values in cubic meters. TOTAL = 13,000,000
Data Source: Draft Environmental Restoration Core Database (February 1996)

2.1.1.4 Overall Projections of Environmental Restoration Contaminated Media, LLW, and MLLW

The majority of non-aqueous media and facilities contaminated with radionuclides will be addressed through in-situ remediation strategies (21 million m^3) and no further action determinations (8.9 million m^3). A final disposition has not yet been determined for 3.3 million m^3 of media and facilities contaminated with radionuclides (see Figure 2.4). In contrast, 5.3 million m^3 of non-aqueous media and facilities with both radionuclides and hazardous contaminants were addressed by in-situ responses (see Figure 2.5). Tables 2.4 and 2.5 summarize how the Environmental Restoration program anticipates addressing contaminated media and facilities. Organized by site and type of environmental restoration strategy, these two tables detail the final disposition of the contaminated media.

The Environmental Restoration program relies substantially on in-situ treatment and containment strategies to address contaminated media. Los Alamos National Laboratory dispositions the largest volume of media contaminated with radionuclides through no further action determinations (8.9 million m^3). Hanford Site anticipates addressing 20 million m^3 of contaminated soils with in-situ remediation strategies. Similarly, Los Alamos National Laboratory dispositions the largest volume of media contaminated with radionuclides and hazardous contaminants through no further action determinations (0.5 million m^3). Savannah River Site anticipates addressing the largest volume of media contaminated with radionuclides and hazardous contaminants utilizing in-situ remediation strategies (3.9 million m^3). Tables 2.4 and 2.5 provide additional details on the volumes of contaminated media and facilities dispositioned through no further action and in-situ containment/treatment remediation processes.

Overall, the Environmental Restoration program projects generating approximately 9.8 million m^3 of LLW and 460,000 m^3 of MLLW. Section 2.3 details how these volume projections will be dispositioned.

Definitions for items presented in Figure 2.3 are as follows:

No Further Action: After consulting with stakeholders and regulatory agencies (whether the Environmental Protection Agency, other federal agencies, or State and local agencies), the Environmental Restoration program may determine that no further action is appropriate. Sites reported a number of elements that have been determined as or are forecasted to require no further action.

Access/Institutional Control and In-situ Treatment and Containment: The Environmental Restoration program plans to manage a significant portion of its contaminated media without physically removing or excavating them, thus generating no LLW or MLLW. If the degree of contamination is relatively low and the volumes relatively large, an appropriate response may be access/institutional control. Public access to the area of contamination is restricted either through land deeds or a barrier such as a fence and posted warnings. The type and degree of contamination may also warrant an in-situ response. These remediation strategies will allow the Environmental Restoration program to address these elements in place and thus minimize or eliminate the generation of LLW and MLLW.

Disposal in Environmental Restoration Facilities: This disposition category consists primarily of disposal in the planned Environmental Restoration program-operated disposal facilities. Appendix A contains a detailed discussion of the Environmental Restoration program's planned disposal facilities. Note that these disposal facilities will accept only on-site remediation LLW or MLLW.

Transfer to Commercial Facility for Disposal: The Environmental Restoration program plans to transfer some of its LLW and MLLW to commercial facilities for disposal (the Department currently transfers waste to the Envirocare facility in Utah; other commercial disposal facilities will be considered as they become available).

Transfer to Waste Management for Treatment & Disposal: In this Report, the transfer of any LLW or MLLW to the Waste Management program for treatment, storage, or disposal is considered a final disposition. At specific sites, the Waste Management program plays a central role in the management of LLW and MLLW remediation either on-site or off-site.

Disposition Not Yet Determined: Some sites did not report a final disposition remediation strategy for specific elements. Examples include collection and treatment or collection and storage (The Report did not consider these remediation strategies as final disposition types) where no additional responses were provided by the sites. Other sites did not have sufficient data to provide an initial volume of contaminated media. Finally, some sites dispositioned only fractions of certain elements. In all these instances, the Report segregated these elements into the disposition not yet determined category.

Table 2.4: Disposition of Non-Aqueous Media and Facilities Contaminated with Radionuclides

Site	No Further Action	In-Situ	Environmental Restoration Management	Waste Management Treatment & Disposal	Commercial Disposal	Not Yet Determined	Total
Nevada Test Site[1]		1,200		1,100,000			**1,100,000**
Nevada Offsite Locations		26,000					**26,000**
Sandia National Laboratories/New Mexico	6.0	14,000		36,000			**50,000**
Inhalation Toxicology Research Institute			300			8,800	**9,100**
Los Alamos National Laboratory	8,900,000	200,000		15,000			**9,100,000**
Pantex Plant			53			0.5	**53**
Rocky Flats Environmental Technology Site			61,000	35,000		290	**96,000**
Lawrence Berkeley Laboratory				9,400			**9,400**
General Atomics			760			430	**1,200**
Laboratory for Energy-Related Health Research				3,800			**3,800**
General Electric Vallecitos Nuclear Center			20				**20**
Energy Technology Engineering Center				1,600			**1,600**
Idaho National Engineering Laboratory		89,000		140,000		180,000	**410,000**
Hanford Site		20,000,000	3,900,000	710		1.0	**24,000,000**
Formerly Utilized Sites Remedial Action Program			250,000		14,000	540	**270,000**
Oak Ridge Reservation		51,000		200,000	840,000	3,900	**1,100,000**
Paducah Gaseous Diffusion Plant			50,000	150		710,000	**760,000**
Portsmouth Gaseous Diffusion Plant			54,000	2,800		690,000	**740,000**
Battelle Columbus Laboratory			710		1,500		**2,200**
Fernald Environmental Management Project			1,800,000	57,000	480,000	6,300	**2,300,000**
Mound Plant				7,600	110,000	51	**120,000**
Reactive Metals, Inc.			30,000			8,500	**38,000**
Savannah River Site	1,800	330,000		410,000		1,700,000	**2,400,000**
Chicago Offsite Locations					15,000		**15,000**
Argonne National Laboratory - East			6,200	2,500	23	7,800	**17,000**
Ames Laboratory						1,400	**1,400**
Argonne National Laboratory - West			150		6.0		**150**
Brookhaven National Laboratory			400	5.0	120,000		**120,000**
Total	**8,900,000**	**21,000,000**	**6,200,000**	**2,000,000**	**1,600,000**	**3,300,000**	**43,000,000**

[1] Nevada Test Site volumes may be disposed by Environmental Restoration.

NOTE: All figures are in m^3 and have been rounded to 2 significant figures. Because of rounding, the totals may not equal the sum of their components.

Data Source: Draft Enviromental Restoration Core Database (February 1996)

Table 2.5: Disposition of Non-Aqueous Media and Facilities Contaminated with Radionuclides and Hazardous Contaminants

Site	No Further Action	In-Situ	Environmental Restoration Management	Waste Management Treatment & Disposal	Commercial Disposal	Not Yet Determined	Total
Nevada Test Site				280			**280**
Nevada Offsite Locations		11,000					**11,000**
Sandia National Laboratories/New Mexico	2,600				1,800		**4,400**
Los Alamos National Laboratory	500,000				980		**500,000**
Rocky Flats Environmental Technology Site	180,000	9,900	70,000	42,000		72,000	**380,000**
Lawrence Berkeley Laboratory		42,000					**42,000**
General Atomics			96			550	**650**
Laboratory for Energy-Related Health Research						4,400	**4,400**
Idaho National Engineering Laboratory		190,000		9,200	2,700	460	**200,000**
Hanford Site			220	100			**320**
Formerly Utilized Sites Remedial Action Program			7,200		11,000		**18,000**
Oak Ridge Reservation		450,000		7,500			**460,000**
Paducah Gaseous Diffusion Plant		240,000	210,000			100	**460,000**
Portsmouth Gaseous Diffusion Plant		270,000	380			1.0	**270,000**
Battelle Columbus Laboratory					1.0	12	**13**
Fernald Environmental Management Project				1,000	1,700	1,400	**4,100**
Reactive Metals, Inc.			20		9.0		**29**
Savannah River Site		3,900,000		68,000	280	6,600,000	**11,000,000**
Chicago Offsite Locations					500		**500**
Argonne National Laboratory - East		140,000	160			1.0	**140,000**
Brookhaven National Laboratory			3,200		16,000		**19,000**
Total	**690,000**	**5,300,000**	**290,000**	**130,000**	**35,000**	**6,700,000**	**13,000,000**

NOTE: All figures are in m^3 and have been rounded to 2 significant figures. Because of rounding, the totals may not equal the sum of their components.

Data Source: Draft Enviromental Restoration Core Database (February 1996)

2.1.2 Nuclear Material and Facility Stabilization LLW and MLLW Projections

The mission of the Nuclear Material and Facility Stabilization program consists of three primary elements: 1) stabilizing and storing nuclear materials prior to final disposition, 2) deactivating surplus facilities, and 3) managing spent nuclear fuel treatment and storage. The Nuclear Material and Facility Stabilization program is responsible for a large number of geographically dispersed sites and facilities, large quantities of radioactive materials in a variety of forms and storage configurations, and an aging complex of processing and production facilities historically used for chemical and physical processing of many different types of nuclear material. The facilities under the purview of the Nuclear Material and Facility Stabilization program include 13 nuclear reactors, 41 radioactive processing facilities, and approximately 3,000 contaminated surplus buildings.

For the life cycle of activities, the Nuclear Material and Facility Stabilization program projected the generation of approximately 100,000 m^3 of LLW (see Table 2.6).

Table 2.6: Nuclear Material and Facility Stabilization LLW Matrices

Matrix Type	Total Volume
organic debris	6,300 m^3
metal debris	2,000 m^3
inorganic nonmetals	1,500 m^3
waste suitable for disposal	85,000 m^3
other waste matrices	8,400 m^3

Data Source: Office of Strategic Planning and Analysis BEMR Data Set (April 1996)

Similarly, over the life cycle of activities, the Nuclear Material and Facility Stabilization program projected the generation of approximately 32,000 m^3 of MLLW (see Table 2.7).

Table 2.7: Nuclear Material and Facility Stabilization MLLW Matrices

Matrix Type	Total Volume
heterogeneous debris	1,800 m^3
lab packs	1,800 m^3
salt waste	1,000 m^3
other final forms	24,000 m^3
other waste matrices	2,800 m^3

Data Source: Office of Strategic Planning and Analysis BEMR Data Set (April 1996)

In developing the Baseline Environmental Management Report Database, the Nuclear Material and Facility Stabilization program assumed that all of its LLW and MLLW will be transferred to the Waste Management program for any required treatment and eventual disposal. The Report also assumed the following:

- all nuclear material and facility stabilization projected volumes transferred to the Waste Management program require disposal, and

- the requisite treatment processes do not increase or decrease the volume of waste.

Table 2.8 lists total LLW and MLLW generation projections by site for the Nuclear Material and Facility Stabilization program.

Table 2.8: Nuclear Material and Facility Stabilization Life Cycle Projections of LLW and MLLW By Site

Site	LLW Volumes (m^3)	MLLW Volumes (m^3)
Nevada Test Site	40	330
Los Alamos National Laboratory	200	0.0
Pinellas Plant	430	0.0
Rocky Flats Environmental Technology Site	11,000	16,000
Lawrence Livermore National Laboratory	350	370
Idaho National Engineering Laboratory	6,400	3.0
Hanford Site	11,000	7,300
Oak Ridge Reservation	10,000	5,800
Savannah River Site	64,000	1,300
Brookhaven National Laboratory	34	0.0
Total	**100,000**	**32,000**

NOTE: All figures have been rounded to 2 significant figures. Because of rounding, the totals may not equal the sum of their components.

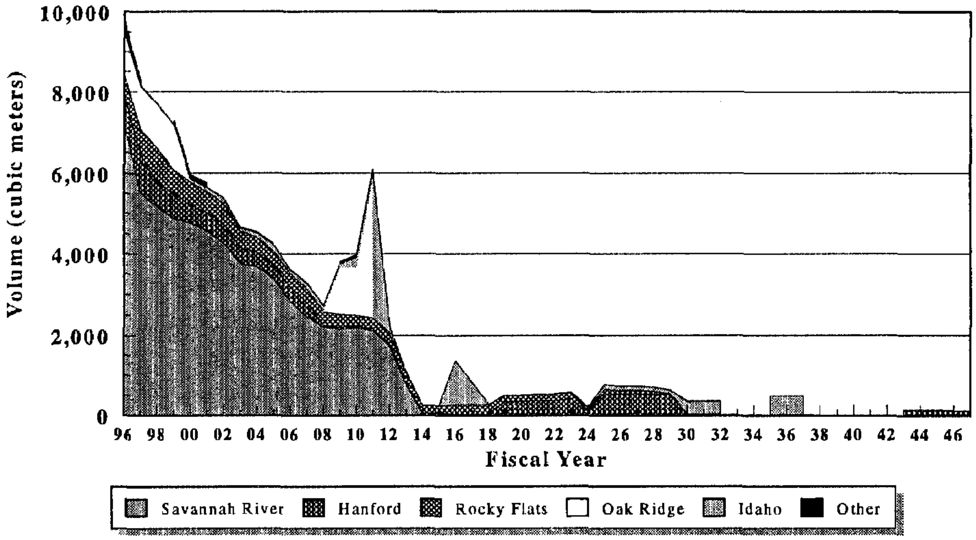
Data Source: Office of Strategic Planning and Analysis BEMR Data Set (April 1996)

Reviewing the annual volumes generated at each site, Hanford Site, Idaho National Engineering Laboratory, and Rocky Flats Environmental Technology Site are the only sites that project the generation of LLW from stabilization and deactivation activities after FY 2015. The same three sites are alone in projecting the generation of MLLW after FY 2013. Rocky Flats

Environmental Technology Site will continue to generate LLW and MLLW through FY 2047. Figures 2.6 and 2.7 provide annual profiles of LLW and MLLW volumes.

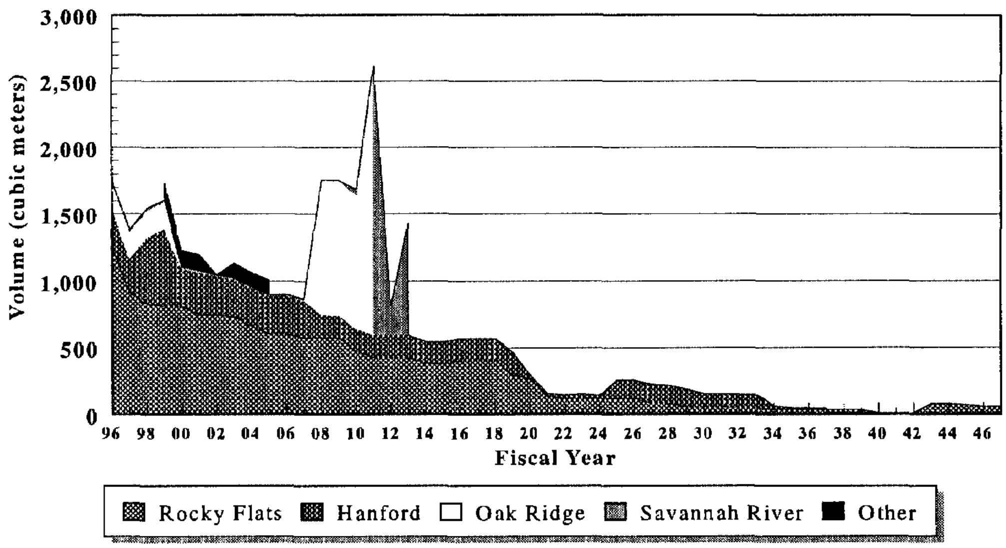
The Nuclear Material and Facility Stabilization program transfers all of its LLW and MLLW to the Waste Management program for disposal. The final disposition of nuclear material and facility stabilization LLW and MLLW will be discussed in Section 2.3 of this Report where final total disposal volumes are compiled.

Figure 2.6: Nuclear Material and Facility Stabilization Annual LLW Projections by Site



Data Source: Office of Strategic Planning and Analysis BEMR Data Set (April 1996)

Figure 2.7: Nuclear Material and Facility Stabilization Annual MLLW Projections by Site



Data Source: Office of Strategic Planning and Analysis BEMR Data Set (April 1996)

2.1.3 Projections from Other Generators

Other generators include Defense Programs, Energy Research, and Nuclear Energy (including the Naval Reactors program). The projected LLW and MLLW volumes generated by these organizations will be managed by the Waste Management program.

2.1.3.1 Other LLW Generator Projections

To better evaluate the LLW generated throughout the life cycle, LLW generation volumes are broken out into specific waste physical forms and generation site. Table 2.9 lists by generator site the waste volume projections of these other generators that will be managed by the Waste Management program (excluding environmental restoration or nuclear material and facility stabilization sources). Table 2.10 provides a detailed breakdown of these volumes shown by waste physical forms description. Figure 2.8 shows life cycle LLW volumes (from 1995 to 2070) for the entire complex by site. All sites in Figure 2.8 generating total life cycle volumes less than 50,000 m^3 are combined into the "Other" category. Figure 2.9 shows the complex-wide life cycle volumes by waste physical forms description. The majority of the "Unknown/Other" category is generated after FY 2030. The "Unknown/Other" waste volumes are generated primarily by Nevada Test Site, Los Alamos National Laboratory, and Savannah River Site. Approximately 71 percent of the total volume reported during this period falls into this category.

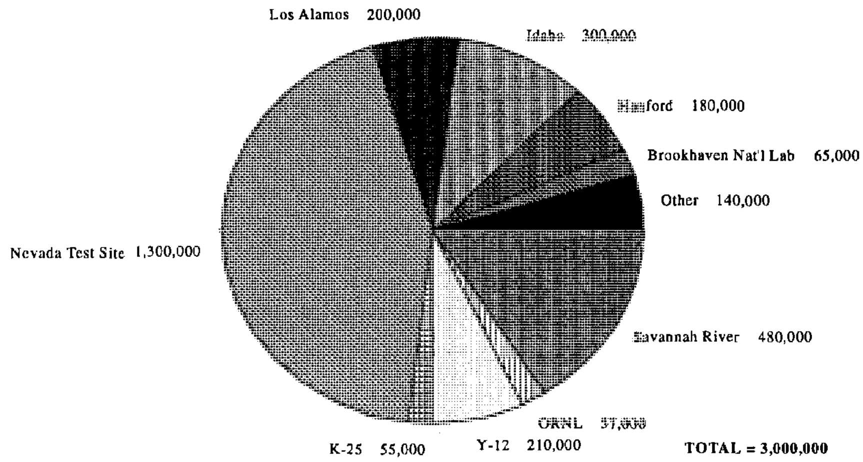
Across the Department of Energy complex, the Waste Management program will be responsible for managing a total of 3.0 million m^3 of LLW, excluding LLW generated by the Environmental Restoration program and the Nuclear Material and Facility Stabilization program. Of the waste reported to the Waste Management program, solid waste makes up the largest part of the current and life cycle inventories. The majority of the solid waste for both the current inventory and the life cycle volume is made up of debris waste (36,000 m^3 and 460,000 m^3, respectively). The sites that reported most of the debris waste were the Hanford Site, Idaho National Engineering Laboratory, and Savannah River Site.

Table 2.9: Waste Management LLW Volumes by Site (m^3)

Sites	1995 Storage Inventory	Total Volume (1996-00)	Total Volume (2001-30)	Total Volume (2031-70)[3]	Total Life Cycle	Disposal Site
Argonne National Laboratory - East	590	4,100	6,800	7,900	19,000	Hanford Site
Ames Laboratory	20	48	110	520	700	Hanford Site
Bettis Atomic Power Laboratory	2,000	670	2,800	0.0	5,400	Savannah River Site
Brookhaven National Laboratory	1,000	760	47,000	17,000	65,000	Hanford Site
Fermi National Accelerator Laboratory	200	66	2,000	1,900	4,100	Hanford Site
Hanford Site	6,200	3,100	120,000	54,000	180,000	Hanford Site
Idaho National Engineering Laboratory	25,000	7,800	230,000	33,000	300,000	Idaho National Engineering Laboratory
Naval Reactor Program	1,400	500	11,000	0.0	13,000	Idaho National Engineering Laboratory
Inhalation Toxicology Research Institute	140	54	1,400	0.0	1,600	Nevada Test Site
Kansas City Plant	16	0.0	12	16	44	Nevada Test Site
Kesslering Atomic Power Laboratory	260	170	4,400	0.0	4,900	Savannah River Site
Knolls Atomic Power Laboratory	400	200	6,000	0.0	6,600	Savannah River Site
Windsor Atomic Power Laboratory	61	9.0	0.0	0.0	70	Savannah River Site
Los Alamos National Laboratory	720	1,800	53,000	140,000	200,000	Los Alamos National Laboratory
Lawrence Berkeley Laboratory[2]	79	9,600	1,300	1,700	13,000	Hanford Site
Lawrence Livermore National Laboratory	880	77	1,600	2,100	4,600	Nevada Test Site
Mound Plant	2,100	240	22,000	0.0	24,000	Nevada Test Site
Nevada Test Site[2]	300	47,000.0	1,100,000	110,000	1,300,000	Nevada Test Site
Oak Ridge Y-12 Plant[1]	23,000	26,000	160,000	0.0	210,000	Oak Ridge Reservation
Oak Ridge K-25 Site[1]	45,000	9,600	0.0	0.0	55,000	Oak Ridge Reservation
Oak Ridge Associated Universities	25	16	510	0.0	550	Oak Ridge Reservation
Oak Ridge National Laboratory[1]	12,000	7,400	37,000	0.0	57,000	Oak Ridge Reservation
Pinellas Plant	240	78	3,200	0.0	3,500	Savannah River Site
Princeton Plasma Physics Laboratory	120	710	3,200	0.0	4,000	Hanford Site
Pantex Plant	600	250	2,800	0.0	3,600	Nevada Test Site
Rocky Flats Environmental Technology Site	5,800	170	2,900	880	9,800	Nevada Test Site
Sandia National Laboratories/California	0.0	30	0.0	0.0	30	Nevada Test Site
Savannah River Site	27,000	14,000	430,000	12,000	480,000	Savannah River Site
Stanford Linear Accelerator Center/Laboratory for Energy-Related Health Research	400	82	530	700	1,700	Hanford Site
West Valley Demonstration Project	17,000	910	42	0.0	18,000	On-Site Storage
Total	**170,000**	**130,000**	**2,300,000**	**390,000**	**3,000,000**	

1	Data after 1994 taken from 1996 Waste Management Baseline Environmental Management Report Database.
2	Data after 1995 taken from 1996 Waste Management Baseline Environmental Managment Report Database.
3	All data after 2030 are taken from 1996 Waste Management Baseline Environmental Management Report Database.
NOTE:	All figures have been rounded to 2 significant figures. Because of rounding, the totals may not equal the sum of their components.
Data Source:	All data except where otherwise stated are taken from the IDB Report - 1994, Rev. 11, September 1995

Figure 2.8: Site-Specific LLW Life Cycle Volumes (cubic meters)



Data Source: IDB Report - 1994, Rev. 11, September 1995 and 1996 Waste Management BEMR Database

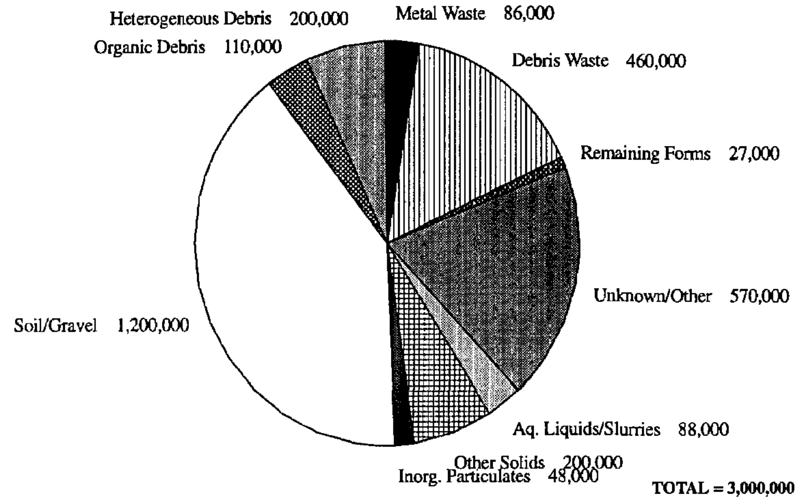
Table 2.10: LLW Volumes by Waste Physical Forms Description

Physical Form	Total Volume (CY 1995)	Total Volume (1996-2000)	Total Volume (2001-2030)	Total Volume (2030-2099)	Total Life Cycle
Debris Waste	36,000	17,000	400,000	100	460,000
Metal Waste	18,000	8,000	48,000	11,000	86,000
Hetergeneous Debris	24,000	17,000	120,000	41,000	200,000
Organic Debris	40,000	8,900	37,000	29,000	110,000
Inorganic Nonmetals Debris	380	6,700	900	1,700	9,600
Soil/Gravel	11,000	30,000	1,100,000	9,900	1,200,000
Homogeneous Solid	2,000	170	1,000	200	3,400
Paint Waste	1.3	0.8	0.0	0.0	2.1
Salt Waste	670	690	4,300	36	5,700
Inorganic Particulates	5,000	800	34,000	8,300	48,000
Unknown/Other Solids	13,000	6,100	180,000	100	200,000
Aqueous Liquids/Slurries	6,100	11,000	62,000	9,900	88,000
Oranic Liquids	530	380	4,700	340	6,000
Unknown/other	15,000	28,000	260,000	270,000	570,000
Compressed gases/aerosols	2,500	0.0	0.4	0.1	2,500
Total	**170,000**	**130,000**	**2,300,000**	**390,000**	**3,000,000**

NOTE: All figures have been rounded to 2 significant figures. Because of rounding, the totals may not equal the sum of their components.

Data Source: IDB Report - 1994, Rev. 11, September 1995 and 1996 Waste Management BEMR Database

Figure 2.9: Life Cycle Volumes by Physical Form (cubic meters)



Data Source: IDB Report - 1994, Rev. 11, September 1995 and 1996 Waste Management BEMR Database

2.1.3.2 Mixed Low-Level Waste Volumes

Based on data compiled from the 1995 Mixed Waste Inventory Report and the 1996 Waste Management Baseline Environmental Management Report Database, the total projected volumes of waste management MLLW will be 220,000 m^3 over the next 75 years (the life cycle of cleanup activities). As these are projections of pretreatment volumes, the eventual disposal-ready volumes may be smaller. Most of the resulting LLW from treatment will be debris, ash, or decontaminated materials, hardware, or equipment. As post-treatment volume projections are not available, the Report includes only pre-treatment volume projections.

2.1.3.3 Liquid Waste Streams

The Department projects that the Waste Management program will manage approximately 6,500 m^3 of liquid low-level radioactive waste, not including wastewater treatment effluents. The residuals will be stabilized and disposed of in accordance with the various treatment technologies applied to liquid LLW. As final disposition volumes are not available at this time, the Report includes only pre-treatment volume projections. Liquid LLW most likely will be treated by a solidification process that will increase the final waste volumes requiring disposal. This volume increase is not captured in the analysis, adding uncertainty to the final disposal volume projections in this Report.

2.1.4 Stored and Legacy LLW and MLLW Volumes

The Department currently stores LLW in a variety of facilities including both conventional and fabric-covered buildings, above ground vaults, pools (high activity waste), and outdoor pads. LLW stored on outdoor pads is usually packaged in Department of Transportation Specification 7A containers and may also be stored inside cargo containers. However, large volumes of bulk contaminated wastes such as soil and scrap metal are also being stored outdoors. Some of the long-term storage of LLW is a result of low priority in funding profiles. Other storage is undertaken as a result of the inability to comply with characterization or certification requirements for off-site shipment. As of 1995, the Waste Management program is managing a total of 170,000 m^3 of LLW and approximately 100,000 m^3 of MLLW in storage. In addition to contaminated media and facilities, the Environmental Restoration program also reported some volumes of stored waste.

The Department generally stores LLW and MLLW for the following reasons:

- to accumulate enough volume for treatment, shipment, or disposal;
- to await funding for shipment, characterization, treatment, or disposal;
- to await characterization or certification;
- to allow time for decay; or
- because of the inability to dispose of the waste.

A small number of sites are placing specific short half-lived LLW into storage for decay and then disposing of it in less controlled landfills after many half-lives. The ratio of short-lived LLW that is stored for decay varies across the Department, accounting for less than one percent of total generation at Hanford Site to about 16 percent at Fermi National Accelerator Laboratory.

2.2 Treatment of LLW

The waste volumes may be in forms that are not ready for final disposal, thus requiring further treatment (as applicable for each waste physical form). Different treatment technologies can be applied to the different forms (liquid, solid, dry solid) of LLW or MLLW. Two primary types of treatment used in LLW management are solidification/stabilization and volume reduction. Technologies used in Department of Energy LLW management usually include the following:

- *Solidification and Stabilization.* These processes are used to convert LLW to a stabilized from to prevent degradation and release of radionuclides.

- *Evaporation.* This is a concentration method that can be used on many different liquid wastes and slurries.

- *Sedimentation and Precipitation.* These processes are used to concentrate the radioactivity of liquid LLW into a small volume of wet solids.

- *Dewatering.* This is a process usually used as a liquid removal technique to treat wet solids. Pumping and gravitational drainage can be used to remove the water from semi-solid LLW. Ion-exchange resins are commonly treated using "in-container dewatering."

- *Combustion.* This technique transforms the waste to a less reactive form and reduces its volume. Incineration is used for combustible dry active waste and LLW containing certain organic liquids and waste oil. Incineration can achieve high volume reduction factors.

- *Compaction.* This technique reduces the physical volume of the waste by mechanical compression.

Solidification/stabilization usually increase volumes for final disposal waste form; volume reduction reduces the volumes requiring final disposal.

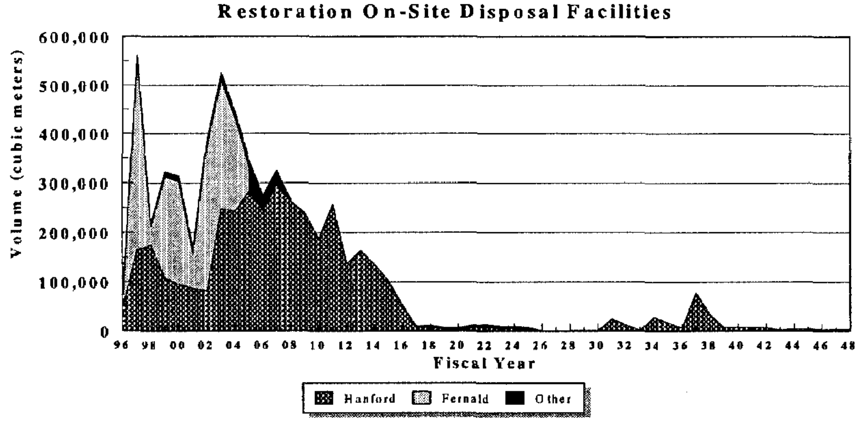
2.3 Disposal Volumes

Disposal volume projections have been categorized into three areas: 1) disposal in facilities operated by the Environmental Restoration program (Section 2.3.1), 2) disposal in commercial facilities (Section 2.3.2), and 3) disposal in facilities operated by the Waste Management program (Section 2.3.3).

2.3.1 LLW and MLLW Projections for Disposal in Environmental Restoration Disposal Facilities

Approximately 6.2 million m^3 of LLW and 290,000 m^3 of MLLW are projected to be disposed of at disposal facilities operated by the Environmental Restoration program. Most of the LLW volumes will be disposed of at Hanford Site and Fernald Environmental Management Project (3.9 million m^3 and 1.8 million m^3, respectively). Figure 2.10 details the annual projections for sites

Figure 2.10: Annual Projections for Environmental Restoration On-Site Disposal Facilities



Data Source: Draft Environmental Restoration Core Database (February 1996)

Table 2.11: Anticipated Environmental Restoration Management of Non-Aqueous LLW Projections

Site	On-Site Disposal	Not Yet Determined	Total
Inhalation Toxicology Research Institute		300	**300**
Pantex Plant		53	**53**
Rocky Flats Environmental Technology Site	61,000		**61,000**
General Atomics		760	**760**
General Electric Vallecitos Nuclear Center		20	**20**
Hanford Site	3,900,000		**3,900,000**
Formerly Utilized Sites Remedial Action Program		250,000	**250,000**
Paducah Gaseous Diffusion Plant		50,000	**50,000**
Portsmouth Gaseous Diffusion Plant		54,000	**54,000**
Battelle Columbus Laboratory		710	**710**
Fernald Environmental Management Project	1,800,000		**1,800,000**
Reactive Metals, Inc.		30,000	**30,000**
Argonne National Laboratory - East		6,200	**6,200**
Argonne National Laboratory - West		150	**150**
Brookhaven National Laboratory		400	**400**
Total	**5,800,000**	**390,000**	**6,200,000**

NOTE: All figures are in m^3 and have been rounded to 2 significant figures. Because of rounding, the totals may not equal the sum of their components.

Data Source: Draft Environmental Restoration Core Database (February 1996)

Table 2.12: Anticipated Environmental Restoration Management of Non-Aqueous MLLW Projections

Site	On-Site Disposal	Not Yet Determined	Total
Rocky Flats Environmental Technology Site	150	70,000	**70,000**
General Atomics		96	**96**
Hanford Site	220		**220**
Formerly Utilized Sites Remedial Action Program	7,200		**7,200**
Paducah Gaseous Diffusion Plant	210,000		**210,000**
Portsmouth Gaseous Diffusion Plant	380		**380**
Reactive Metals, Inc.		20	**20**
Argonne National Laboratory - East		160	**160**
Brookhaven National Laboratory		3,200	**3,200**
Total	**220,000**	**74,000**	**290,000**

NOTE: All figures are in m^3 and have been rounded to 2 significant figures. Because of rounding, the totals may not equal the sum of their components.

Data Source: Draft Environmental Restoration Core Database (February 1996)

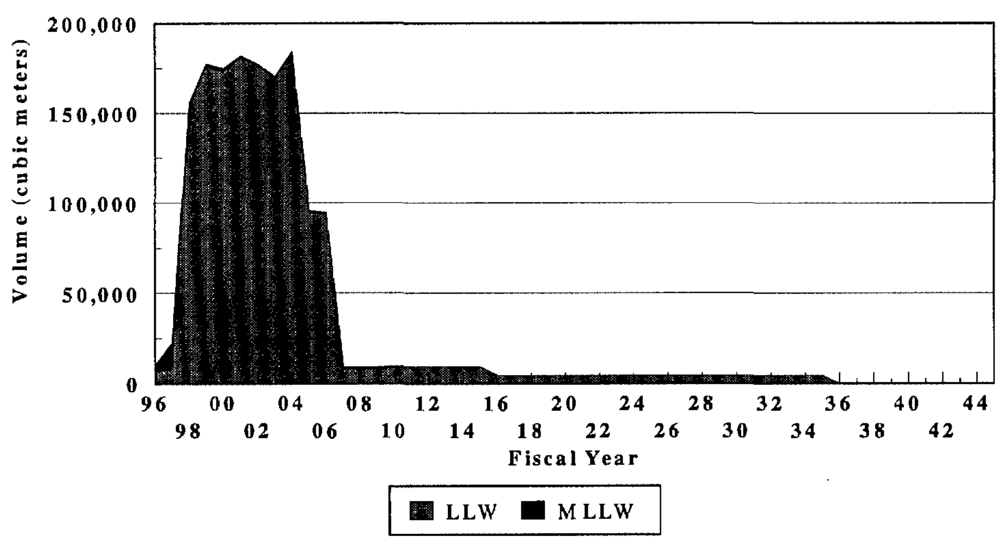
receiving LLW for disposal. Tables 2.11 and 2.12 detail environmental restoration LLW and MLLW management projections. Of the 6.2 million m^3 of LLW projected for management by the Environmental Restoration program, 390,000 m^3 are LLW projections which sites designated as managed by the Environmental Restoration program yet did not provide complete information regarding the eventual disposition. An example of the volumes which sites projected will be managed by the Environmental Restoration program is the 250,000 m^3 of Formerly Utilized Sites Remedial Action Program LLW. Generally, Formerly Utilized Sites Remedial Action Program sites are sending LLW to commercial disposal facilities (the Department currently transfers waste to the Envirocare facility in Utah; other commercial disposal facilities will be considered as they become available). Working with stakeholders and regulators, some contaminated media may also be addressed with in-situ containment strategies.

Appendix A provides additional details on the three environmental restoration-operated disposal facilities at Fernald Environmental Management Project, Hanford Site, and Rocky Flats Environmental Technology Site.

2.3.2 LLW and MLLW Projections for Disposal in Commercial Disposal Facilities

The Environmental Restoration program projects that 1.6 million m^3 of LLW and 35,000 m^3 of MLLW will be transferred to commercial facilities for disposal (the Department currently transfers waste to the Envirocare facility in Utah; other commercial disposal facilities will be considered as they become available). Figure 2.11 provides a profile of the annual volumes of LLW and MLLW to be transferred to commercial disposal facilities for disposal.

Figure 2.11: Annual Waste Projections for Transfer to Commercial Facilities



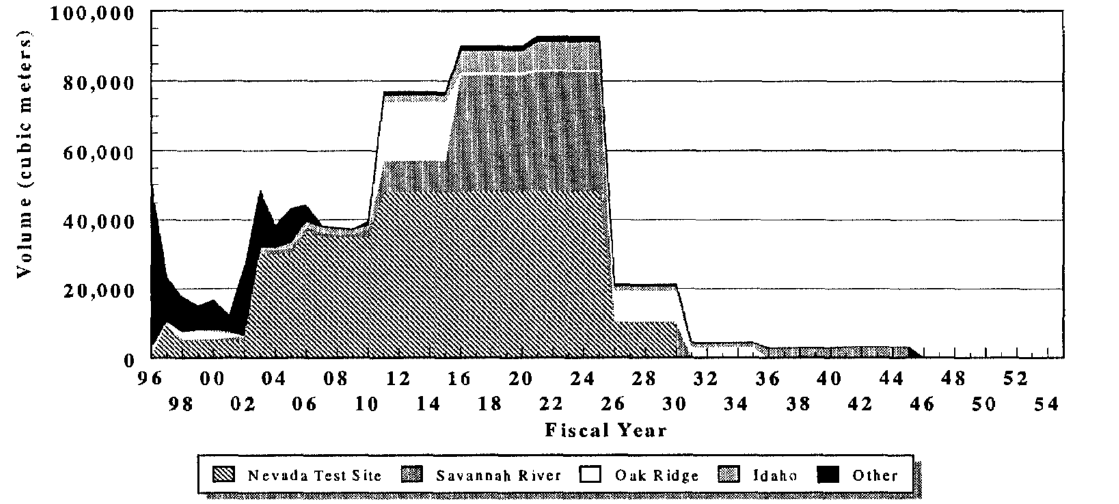
Data Source: Draft Environmental Restoration Core Database (February 1996)

Oak Ridge Reservation and Fernald Environmental Management Project will transfer the largest volumes of LLW to commercial disposal facilities (840,000 m^3 and 480,000 m^3, respectively). Only Oak Ridge Reservation projects sending LLW to commercial disposal facilities beyond FY 2030. Only Brookhaven National Laboratory and Idaho National Engineering Laboratory project sending MLLW to commercial facilities beyond FY 2005. The Waste Management program utilizes Envirocare less frequently than the Environmental Restoration program because its LLW is generally of higher activity than that managed by the Environmental Restoration program, and is less likely to either meet Envirocare's waste acceptance criteria or be cost effective.

2.3.3 LLW and MLLW Projections for Disposal in Waste Management Disposal Facilities

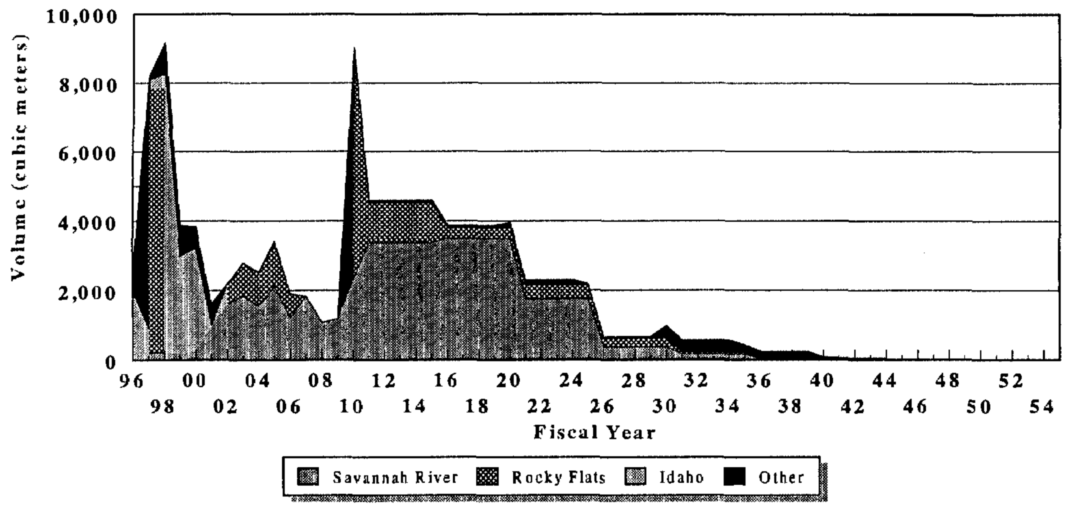
The Environmental Restoration program generator sites project they will transfer 2.0 million m^3 of LLW and 130,000 m^3 of MLLW to treatment and disposal facilities managed by the Waste Management program. Only Idaho National Engineering Laboratory, Oak Ridge Reservation, and Rocky Flats Environmental Technology Site project transferring LLW beyond FY 2040. Oak Ridge Reservation and Rocky Flats Environmental Technology Site are the only two sites that project transferring MLLW beyond FY 2040. Rocky Flats Environmental Technology Site anticipates transferring LLW and MLLW generated by decommissioning activities through FY 2055. Figures 2.12 and 2.13 detail annual volumes of LLW and MLLW projected for transfer to the Waste Management program by Environmental Restoration program generator site.

Figure 2.12: Annual LLW Projections for Transfers to Waste Management by Environmental Restoration Generator Sites



NOTE: These are off-site and intra-site transfers. LLW may be disposed at other Waste Management sites.
Data Source: Draft Environmental Restoration Core Database (February 1996)

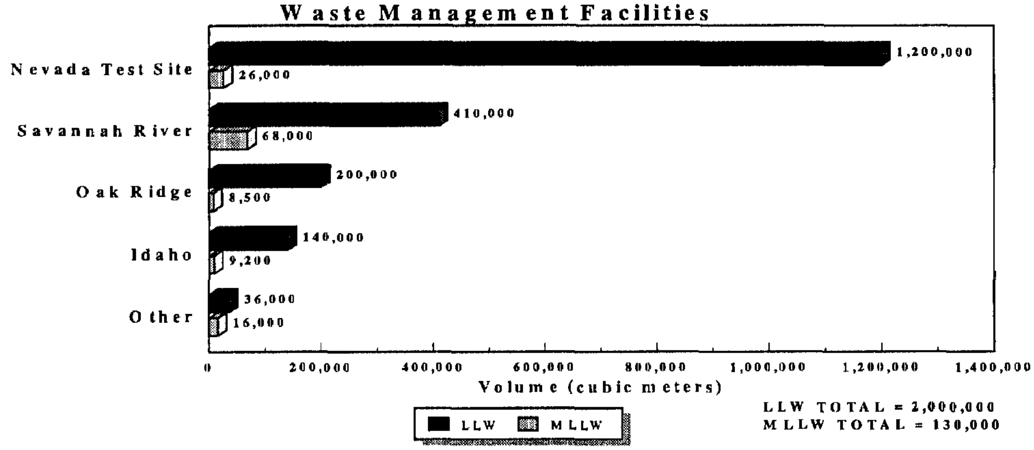
Figure 2.13: Annual MLLW Projections for Transfers to Waste Management by Environmental Restoration Generator Sites



NOTE: These are off-site and intra-site transfers. LLW may be disposed at other Waste Management sites.
Data Source: Draft Environmental Restoration Core Database (February 1996)

Nevada Test Site and Savannah River Site are projected to receive the largest volumes of LLW (1.2 million m^3 and 410,000 m^3, respectively). Savannah River Site receives the most MLLW (68,000 m^3). Figure 2.14 shows the life cycle projections for LLW and MLLW volumes to be disposed at Waste Management program disposal facilities. Only Idaho National Engineering Laboratory, Nevada Test Site, and Oak Ridge Reservation are projected to receive LLW beyond FY 2040. Nevada Test Site, Oak Ridge Reservation, and Savannah River Site are alone in receiving MLLW beyond FY 2006. Field personnel submitting projections data generally also provided information regarding the recipient disposal facility. If no information regarding the recipient disposal facility was provided, the analysis in this Report used the current waste management configuration (as detailed in Table 1.1) to disposition the projected waste.

Figure 2.14: Life Cycle Projections for Disposal at Waste Management Facilities



NOTE: These projected volumes nclude both off-site and intra-site transfers. Once finalized, the WM PEIS will modify these projections.
Data Source: Draft Environmental Restoration Core Database (February 1996)

As noted in Section 2.1.3.2, the analysis in this Report does not include MLLW disposal volumes because post-treatment volume data were not available. This information is being developed through the Federal Facility Compliance Act process and will be included in Revision 1 of this Report.

Table 2.13, Total Life Cycle Volume for the Waste Management Program Disposition of LLW, is organized by final disposal site. The "Unspecified" category in Table 2.13 represents the LLW volume at the West Valley Demonstration Project, which is currently placing all LLW into on-site storage and awaiting a Record of Decision on a site environmental impact statement to help determine the final disposition of its LLW. The "Unspecified" category for the Nuclear Material and Facility Stabilization program represents waste volumes where no treatment, storage, or disposal site was designated.

Table 2.13: Total Life Cycle Volume for Waste Management Disposition of LLW (m^3)

Sites	Total Transfer from Environmental Restoration	Total Transfer from Nuclear Material and Facility Stabilization	Waste Management Waste	Total
Hanford Site	21,000	22,000	290,000	333,000
Idaho National Engineering Laboratory	140,000	6,400	310,000	460,000
Los Alamos National Laboratory	15,000	200	200,000	210,000
Nevada Test Site	1,200,000	40	1,300,000	2,500,000
Oak Ridge Reservation	200,000	10,000	320,000	520,000
Savannah River Site	410,000	64,000	500,000	980,000
Unspecified		810	18,000	19,000
Total	**2,000,000**	**100,000**	**3,000,000**	**5,000,000**

NOTE: All figures have been rounded to 2 significant figures. Because of rounding, the totals may not equal the sum of their components.

Data Sources: IDB Report - 1994, Rev. 11, September 1995 and 1996 Waste Management BEMR Database
Draft Environmental Restoration Core Database (February 1996)
Office of Strategic Planning and Analysis BEMR Data Set (April 1996)

3.0 Disposal Capacity

Section 2.0 compiled the Department's current projections for the generation of LLW and MLLW from cleanup activities and other missions over the next 75 years. Section 3.0 compiles the current and planned available LLW disposal capacity information and compares it against the LLW projections as a preliminary evaluation of adequacy. Section 3.1 summarizes the available disposal capacity for current and planned Department of Energy disposal facilities located at eight sites. Section 3.2 provides a site-by-site comparison of projections and volumetric capacity estimates. Section 3.3 briefly discusses commercial disposal. Appendix A provides additional information on the disposal facilities.

3.1 Department of Energy Current and Planned Available LLW Disposal Capacity

To determine current and planned available LLW disposal capacity, the analysis in this Report examined data in preliminary Performance Assessments and technical documents. Field personnel also were surveyed. The preliminary Performance Assessment data were supplemented as appropriate with recent disposal activity information. To a great extent, field personnel's best professional judgment determined whether plans were judged sufficiently probable (and thus considered in the Report) or very preliminary (and therefore excluded from the Report). The following disposal facility plans were judged very preliminary and were excluded:

- Oak Ridge Reservation Class I Facility, Class II Facility, and Class III/IV Below Ground Disposal Facility;
- Oak Ridge Reservation on-site disposal facility (operated jointly by the Environmental Restoration and Waste Management programs);
- Los Alamos National Laboratory Technical Area-67 Mixed Waste Disposal Facility;
- Rocky Flats Environmental Technology Site Resource Conservation and Recovery Act Subtitle C disposal cell;
- Portsmouth Gaseous Diffusion Plant on-site disposal cell (operated by the Environmental Restoration program); and
- Paducah Gaseous Diffusion Plant on-site disposal cell (operated by the Environmental Restoration program).

The Environmental Restoration Disposal Facility at Hanford Site is considered current for the purposes of this Report because the construction of its initial two cells is nearly complete (scheduled to begin operations in August 1996).

Table 3.1 summarizes the current and planned available disposal capacity of disposal facilities at Department of Energy sites.

Table 3.1: Overview of Department of Energy LLW and MLLW Disposal Facilities

Site	Managing Program	Facility	Current and Planned Available Capacity (m^3)
Los Alamos National Laboratory[a]	Waste Management	Technical Area-54 MDA G	280,000
Idaho National Engineering Laboratory[b]	Waste Management	Radioactive Waste Management Complex	39,000
Nevada Test Site[c]	Waste Management	Area 3 Radioactive Waste Management Site	1,800,000
		Area 5 Radioactive Waste Management Site	1,200,000
Oak Ridge National Laboratory[d]	Waste Management	Solid Waste Storage Area-6 & Interim Waste Management Facility	6,700
Hanford Site[e]	Waste Management	Burial Ground 218-W-5	85,000
		Burial Grounds, 218-W-3AE, 218-W-4C, 218-E-10, and 218-E-12B; Burial Ground 281-W-6	1,100,000
		Radioactive Mixed Waste Land Disposal Facility	43,000
	Environmental Restoration	Environmental Restoration Disposal Facility[f]	3,900,000
Fernald Environmental Management Project[g]	Environmental Restoration	On-site Disposal Cell	1,800,000
Rocky Flats Environmental Technology Site[h]	Environmental Restoration	Corrective Action Management Unit	77,000
Savannah River Site[i]	Waste Management	E-Area Vaults	1,100,000

a Personal communication with Charles Peper, University of California, regarding correspondence to Alan Icenhour and Steve Storch, IDB Program, ORNL, Oak Ridge, Tennessee, "Subject Reports for 1995 Low-Level Waste," CST-14-95-383, dated July 31, 1995.
"Performance Assessment of the LANL TA-54 Area G LLW Disposal Facility," August 1995, Los Alamos National Laboratory.

b "Environmental Impact Statement" (DOE/EIS-0203), April 1994.

c Draft submittal to 1996 BEMR Volume II, March 1996.
Carol Shelton, Nevada Operation Office.

d "Performance Assessment for Continuing and Future Operations at Solid Waste Storage Area 6" (ORNL-6783), February 1994, Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee.
A.L. Rivera, Lockheed Martin Energy Systems, Inc, Tennessee, correspondence to S.N. Storch, IDB Program, ORNL, Oak Ridge, Tennessee, "Low-Level Waste (LLW) Data Call for 1995," dated July 31, 1995.

e "Low-Level Waste Burial Ground Disposal Plan" (WHC-SD-WH-ES-355).

f "Record of Decision for the Hanford Environmental Restoration Disposal Facility, Hanford Site," January 1995.

g "Recommendations on Remediation Levels, Waste Disposition, Priorities, and Future Use," July 1995, The Fernald Citizens Task Force.

h "Conceptual Design Report: Waste Management Facility for Rocky Flats Environmental Technology Site, Golden, Colorado," August 1995, U.S. Department of Energy, Rocky Flats Field Office.

i "Radiological Performance Assessment for the E-Area Vaults Disposal Facility," Westinghouse Savannah River Company.

Table 3.2 summarizes current and planned volumetric disposal capacity at the eight Department of Energy sites.

Table 3.2: Disposal Site Capacity

Disposal Site	Environmental Restoration-Operated Facilities	Waste Management-Operated Facilities	Total
Fernald Environmental Management Project	1,800,000		1,800,000
Hanford Site	3,900,000	1,300,000	5,200,000
Idaho National Engineering Laboratory		39,000	39,000
Los Alamos National Laboratory		280,000	280,000
Nevada Test Site		3,000,000	3,000,000
Oak Ridge Reservation		6,700	6,700
Rocky Flats Environmental Technology Site	77,000		77,000
Savannah River Site		1,100,000	1,100,000
Total	**5,800,000**	**5,700,000**	**11,500,000**

NOTE: The Environmental Restoration program's planned capacity for Hanford Site's Environmental Restoration Disposal Facility equals the projected volumes destined for this facility. The current capacity for the Environmental Restoration Disposal Facility equals the capacity of the two cells to be completed by August 1996. All figures have been rounded to 2 significant figures. Because of rounding, the totals may not equal the sum of their components. Environmental restoration facilities solely accept on-site remediation and decommissioning waste streams.

The Department's current strategy for disposition of the projected 13 million m^3 of LLW is outlined as follows (Figure 3.1 details current Department of Energy plans for disposing of LLW projections):

- Approximately 7.8 million m^3 of LLW from environmental restoration activities will be managed by the Environmental Restoration program.
    - -- 5.8 million m^3 of LLW will be disposed in current and planned disposal facilities designed solely for on-site remediation wastes and operated by the Environmental Restoration program;
    - -- 1.6 million m^3 of LLW will be transferred to commercial disposal facilities (the Department currently transfers waste to the Envirocare disposal facility in Utah; other commercial disposal facilities will be considered as they become available); and
    - -- specific waste disposition strategies for approximately 390,000 m^3 of LLW have not yet been identified.
- Approximately 5.0 million m^3 of LLW will require disposal at facilities operated by the Waste Management program.
- Treatment and volume reduction technologies will further reduce these LLW projections, lessening disposal capacity requirements.

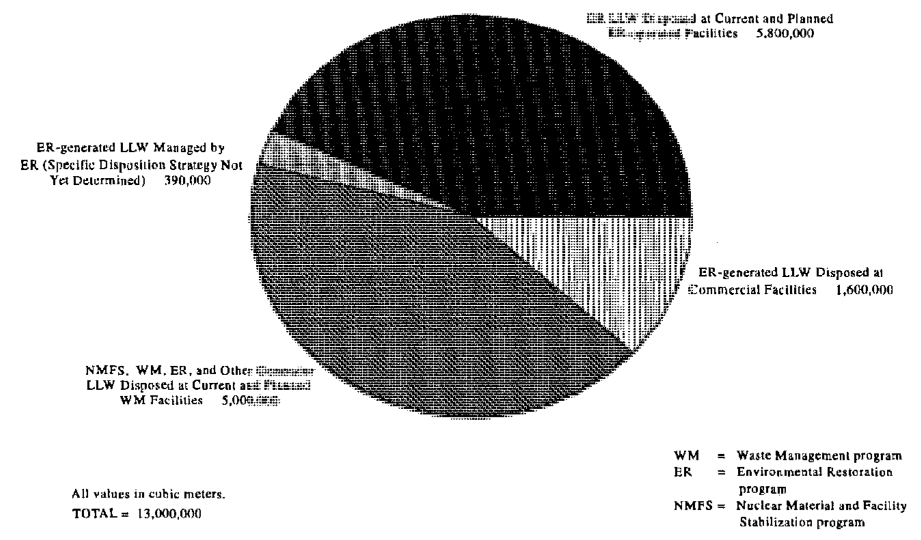
To meet LLW disposal requirements, the Department has current and planned available disposal capacity of 11.5 million m^3 and plans to send to commercial facilities approximately 1.6 million m^3 of LLW. Therefore, on a complex-wide basis the current and planned available disposal capacities of the Department's disposal facilities appear to be adequate for managing the projected LLW volumes for the foreseeable future. In addition, the volume of LLW requiring disposal likely will be less than the reported projections when the following two factors are considered:

- The analysis in this Report did not consider any volume reduction prior to disposal (a number of sites either have implemented or are evaluating significant volume reduction initiatives to reduce the volume of waste requiring disposal); and

- A waste minimization strategy for LLW is being developed as part of Task VIII.3.a of the Defense Nuclear Facilities Safety Board Recommendation 94-2 Implementation Plan (Revision I). As recommendations from this Task will be incorporated into the Department's waste minimization program, the volume of waste requiring disposal will be reduced.

In addition, should future LLW projections exceed those contained in this Report, a number of steps could be taken to accommodate the increased disposal needs. Several potential on-site Department of Energy disposal facilities were not included in this analysis because they are considered very preliminary. Should additional disposal needs be projected, these facilities could be developed. In addition, the Department is investigating the increased use of commercial disposal facilities. While this analysis determined that there is adequate disposal capacity on a complex-wide basis, changes in site-specific waste management and disposition strategies (e.g., increased volume reduction, off-site shipment configuration, greater use of commercial facilities, and increased on-site disposal) may be required. Section 3.2 details site-specific disposal capacity issues.

Figure 3.1: Current Department of Energy Plans for Disposing of LLW Projections



3.2 Site-Specific Disposal Capacity

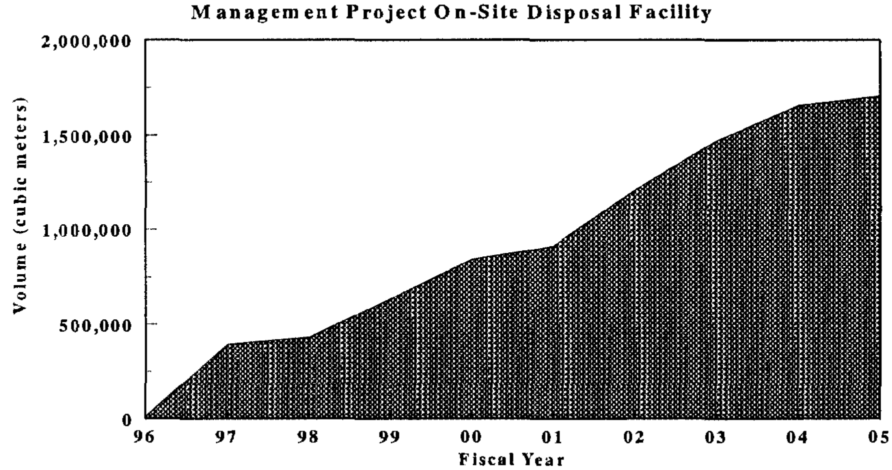
For LLW disposal capacity at environmental restoration disposal facilities, the Report does not set a limit for disposal capacity, as facilities in the Report are designed and approved by regulators to solely receive the projected on-site remediation and decommissioning waste streams. For LLW volumetric disposal capacity at the Waste Management program-operated disposal facilities, the Report dispositioned the projected LLW volumes (from all generators) and compared them to current and planned disposal at the Waste Management program-operated disposal facilities. Each site-specific disposal capacity discussion includes a graph through FY 2020 comparing projections to current and planned available capacity. The graphs also account for past disposal at the waste management facility.

The Waste Management program-operated disposal facilities at Oak Ridge Reservation in particular do not appear to have adequate volumetric disposal capacity to meet projected disposal requirements. However, these sites are investigating other options to meet their waste disposal needs.

3.2.1 Fernald Environmental Management Project

The volume of environmental restoration LLW projected for disposal at Fernald Environmental Management Project is 1.8 million m^3. Fernald Environmental Management Project's planned disposal facility has a capacity of 1.8 million m^3 of LLW. Figure 3.2 details the cumulative volumes of LLW planned for disposal at the Fernald Environmental Management Project On-Site Disposal Facility. Disposal activities will be completed by FY 2005.

Figure 3.2: Cumulative Projections for the Fernald Environmental Management Project On-Site Disposal Facility

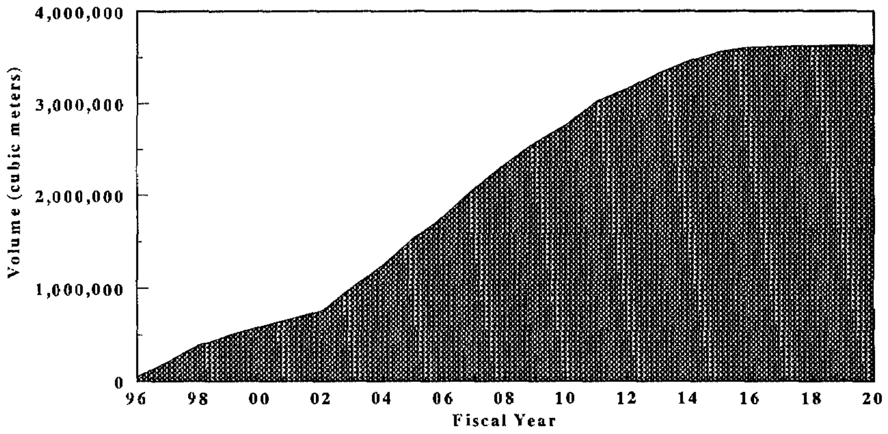


Data Source: Draft Environmental Restoration Core Database (February 1996)

3.2.2 Hanford Site

The volume of environmental restoration activity LLW projections for disposal at the Environmental Restoration Disposal Facility is 3.9 million m^3. The Environmental Restoration Disposal Facility's initial phase, which will be operational in August 1996, has a capacity of 920,000 m^3. The Environmental Restoration program projects that the Environmental Restoration Disposal Facility will receive a total of 3.9 million m^3 of LLW. Figure 3.3 details the cumulative volumes of LLW projected for disposal in the Environmental Restoration Disposal Facility.

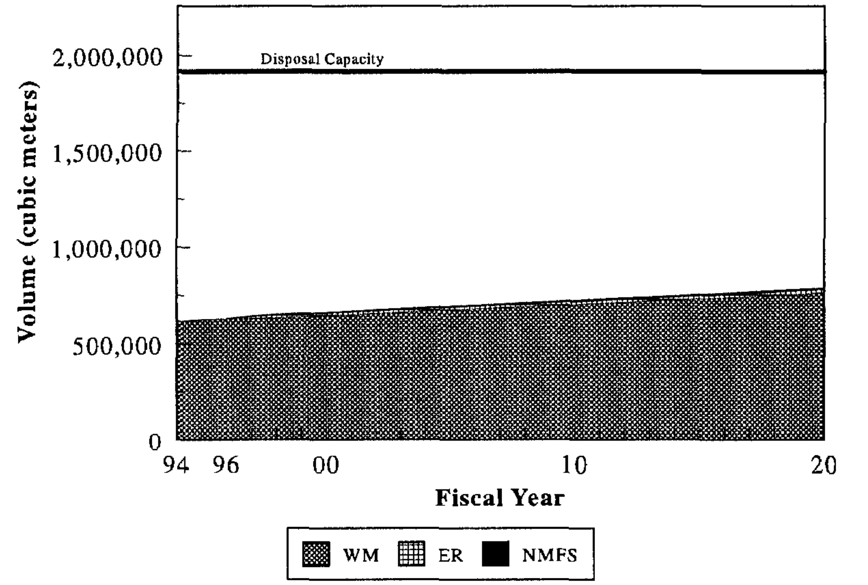
Figure 3.3: Cumulative Projections for the Hanford Site Environmental Restoration Disposal Facility



Data Source: Draft Environmental Restoration Core Database (February 1996)

Figure 3.4 compares current and planned available LLW capacity for Waste Management program-operated disposal facilities against all on-site and off-site Department of Energy LLW cumulative projections for disposal at these facilities through FY 2020. The data in Figure 3.4 also accounts for approximately 600,000 m^3 of past disposal activity. This comparison indicates that the total of current and planned volumetric LLW disposal capacity at Waste Management program-operated facilities is sufficient for the projected volumes from cleanup and other mission activities.

Figure 3.4: Hanford Site Cumulative Projections and Disposal Capacity



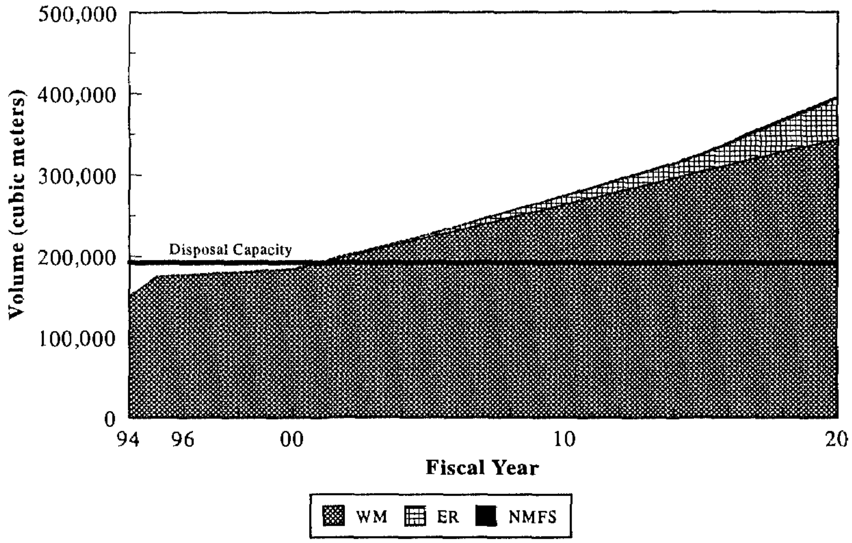
Data Sources: "Low Level Waste Burial Grounds Disposal Plan" (WHC-SD-WH-ES-355)
IDB Report - 1994, Rev. 11, September 1995 and 1996 Waste Management BEMR Database
Draft Environmental Restoration Core Database (February 1996)
Office of Strategic Planning and Analysis BEMR Data Set (April 1996)

3.2.3 Idaho National Engineering Laboratory

Figure 3.5 compares the current and planned available LLW disposal capacity against cumulative projections of on-site Department of Energy LLW. Idaho National Engineering Laboratory does not accept off-site LLW for disposal (both the Naval Reactors program and Argonne National Laboratory-West are considered on-site waste generators for the purposes of the Report).

The current disposal capacity is 39,000 m^3. The comparison in this Report determined that this disposal facility has volumetric capacity to meet projections only through FY 2000. However, this comparison does not account for the impact of volume reduction and waste minimization practices. Because these practices are waste stream-specific and site-specific, the comparisons in this Report did not account for them. Currently, approximately 60 percent of Idaho National Engineering Laboratory LLW undergoes volume reduction. Taking into account volume reduction processes, the projected fill date is FY 2006. Should additional volume reduction initiatives that are now in the planning stages be implemented, the fill date is extended to FY 2020.

Figure 3.5: Idaho National Engineering Laboratory Cumulative Projections and Disposal Capacity

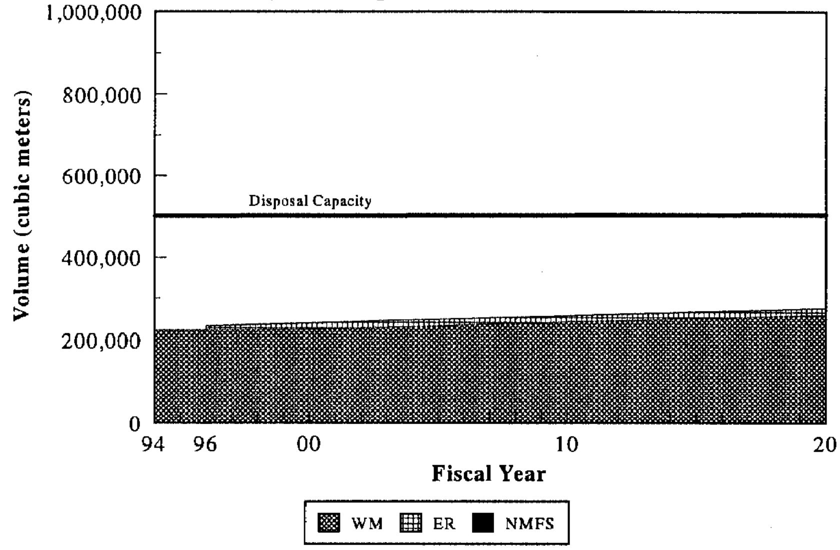


Data Sources: "Environmental Impact Statement" (DOE/EIS-0203), April 1994
IDB Report - 1994, Rev. 11, September 1995 and 1996 Waste Management BEMR Database
Draft Environmental Restoration Core Database (February 1996)
Office of Strategic Planning and Analysis BEMR Data Set (April 1996)

3.2.4 Los Alamos National Laboratory

Figure 3.6 compares current and planned available LLW disposal capacity of the Los Alamos National Laboratory Technical Activity-54 MDA G disposal facility against on-site Department of Energy LLW cumulative projections through FY 2020. In the current LLW management configuration, Los Alamos National Laboratory does not accept any off-site LLW. LLW projections indicate that the current and planned volumetric capacity is adequate for the projected volumes from cleanup and ongoing mission activities (through FY 2070).

Figure 3.6: Los Alamos National Laboratory Cumulative Projections and Disposal Capacity



Data Sources: Personal communication with Charles Peper, University of California, regrading correspondence to Alan Icenhour and Steve Storch, IDB Program, ORNL, Oak Ridge, Tennessee, "Subject Reports for 1995 Low Level Waste," CST-14-95-383, dated July 31, 1995

IDB Report - 1994, Rev. 11, September 1995 and 1996 Waste Management BEMR Database

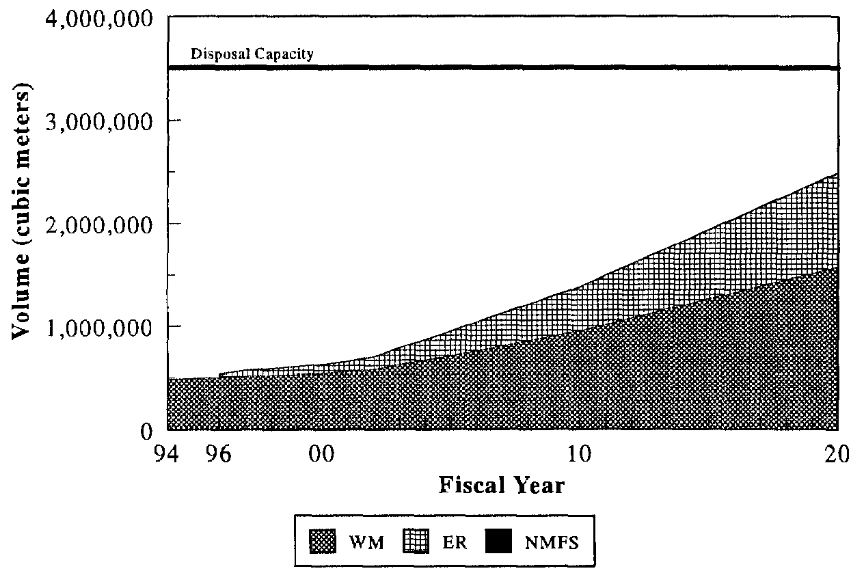
Draft Environmental Restoration Core Database (February 1996)

Office of Strategic Planning and Analysis BEMR Data Set (April 1996)

3.2.5 Nevada Test Site

Figure 3.7 compares current and planned available LLW disposal capacity against on-site and off-site Department of Energy LLW cumulative projections through FY 2020. LLW projections indicate that the current and planned volumetric capacity is adequate for the projected volumes from cleanup and ongoing mission activities (through FY 2070).

Figure 3.7: Nevada Test Site Cumulative Projections and Disposal Capacity

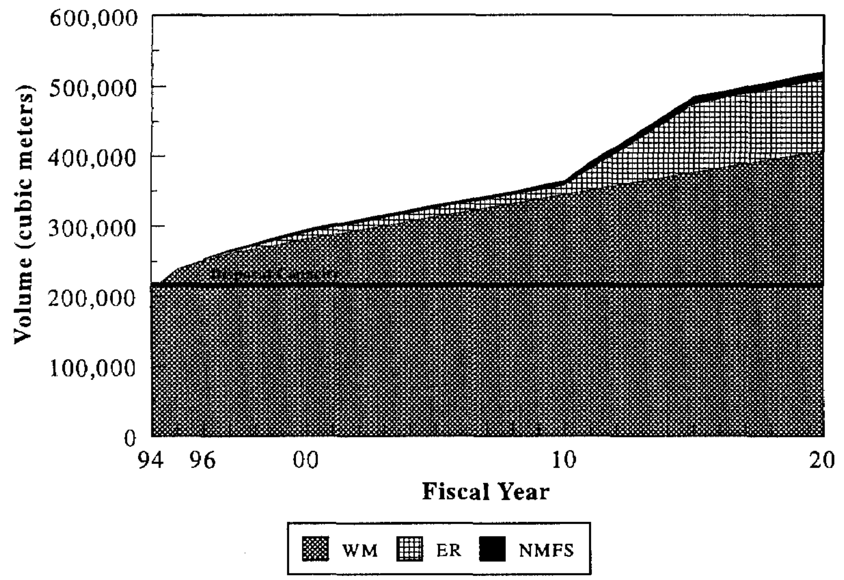


Data Sources: Draft submittal to 1996 BEMR Volume II, March 1996
IDB Report - 1994, Rev. 11, September 1995 and 1996 Waste Management BEMR Database
Draft Environmental Restoration (February 1996)
Office of Strategic Planning and Analysis BEMR Data Set (April 1996)

3.2.6 Oak Ridge Reservation

Figure 3.8 compares current and planned available LLW disposal capacity against cumulative projections of on-site Department of Energy LLW. The Oak Ridge Reservation disposal facility does not have adequate volumetric disposal capacity. As legacy waste (significant amounts of which are contaminated or activated metals) currently stored at Oak Ridge Reservation is the primary source of LLW requiring disposal, smelting for recycle or reuse could lessen the capacity concerns in the near-term. Oak Ridge Reservation is investigating other waste management options and currently is waiting for approval to ship LLW to the Nevada Test Site.

Figure 3.8: Oak Ridge Reservation Cumulative Projections and Disposal Capacity



Data Sources: "Performance Assessment for Continuing and Future Operations of Solid Waste Storage Area 6" (ORNL-6783), February 1994, Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee, and A.L. Rivera, Lockheed Martin Energy Systems, Inc., correspondence to S.N. Storch, IDB Program, ORNL, Oak Ridge, Tennessee, "Low-Level Waste Data Call for 1995," dated July 31, 1995
IDB Report - 1994, Rev. 11, September 1995 and 1996 Waste Management BEMR Database
Draft Environmental Restoration Core Database (February 1996)
Office of Strategic Planning and Analysis BEMR Data Set (April 1996)

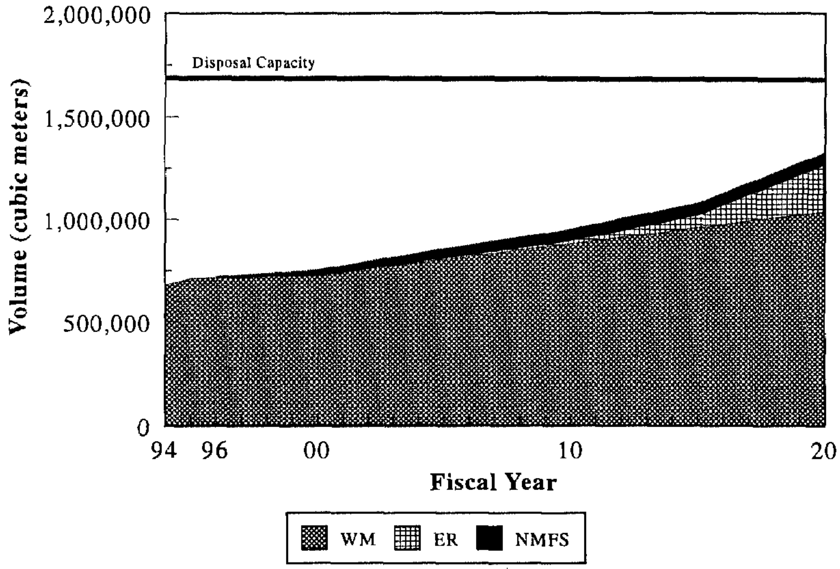
3.2.7 Rocky Flats Environmental Technology Site

The Rocky Flats Environmental Technology Site Corrective Action Management Unit is projected to have a capacity of 77,000 m^3 of either LLW or MLLW.

3.2.8 Savannah River Site

Figure 3.9 compares the current and planned available LLW disposal capacity against on-site and off-site Department of Energy LLW cumulative projections through FY 2020. LLW projections indicate that the current and planned volumetric capacity is adequate for the projected volumes from cleanup and ongoing mission activities (through FY 2070).

Figure 3.9: Savannah River Site Cumulative Projections and Disposal Capacity



Data Sources: "Radiological Performance Assessment for the E-Area Vaults Disposal Facility," Westinghouse Savannah River Company
IDB Report - 1994, Rev. 11, September 1995 and 1996 Waste Management BEMR Database
Draft Environmental Restoration Core Database (February 1996)
Office of Strategic Planning and Analysis BEMR Data Set (April 1996)

3.3 Commercial Disposal of LLW

Envirocare is currently the only commercial disposal facility accepting Department of Energy LLW and MLLW; other commercial disposal facilities will be considered as they become available. The Department currently has two contracts with Envirocare, one for disposal of LLW and the other for the disposal of MLLW. Waste disposed at Envirocare is bulk low-specific activity LLW and MLLW. The Report did not analyze disposal capacity at the Envirocare facility.

4.0 Summary

The Department projects that over the next 75 years (FY 1996 - 2070) its cleanup activities and ongoing missions will generate approximately 13 million m^3 of LLW and 810,000 m^3 of MLLW.

- Stabilization and deactivation activities performed by the Nuclear Material and Facility Stabilization program will generate approximately 100,000 m^3 of LLW and 32,000 m^3 of MLLW.

- Remediation and decommissioning activities performed by the Environmental Restoration program will generate approximately 9.8 million m^3 of LLW and 460,000 m^3 of MLLW[1].

- Other Department of Energy missions (e.g., Defense Programs, Energy Research, and Nuclear Energy (including the Naval Reactors program)) as well as the Waste Management program will generate 2.8 million m^3 of LLW and 220,000 m^3 of MLLW.

- The Waste Management program also is responsible for the final disposition of approximately 170,000 m^3 of legacy LLW and 100,000 m^3 of legacy MLLW in storage.

The Department's current strategy for disposition of the projected 13 million m^3 of LLW and 810,000 m^3 of MLLW is outlined as follows:

- Approximately 7.8 million m^3 of LLW and 330,000 m^3 of MLLW from environmental restoration activities will be managed by the Environmental Restoration program.

    -- 5.8 million m^3 of LLW will be disposed in current and planned disposal facilities designed solely for on-site remediation wastes and operated by the Environmental Restoration program;

    -- 1.6 million m^3 of LLW and 35,000 m^3 of MLLW will be transferred to commercial disposal facilities (the Department currently transfers waste to the Envirocare disposal facility in Utah; other commercial disposal facilities will be considered as they become available); and

---

[1]Approximately 56 million m^3 of environmental media and facilities contaminated with radionuclides are in the scope of the Environmental Restoration program. Final determination of the disposition of the contaminated media and facilities will be developed pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act and the Resource Conservation and Recovery Act regulatory processes. The current strategy for the majority of this material is either no further action or in-situ remediation strategies. A disposition strategy for a fraction of this material (approximately 10 million m^3) has yet to be determined but is expected in the near future.

-- specific waste disposition strategies for approximately 390,000 m^3 of LLW and 290,000 m^3 of MLLW have not been identified yet.

- Approximately 5.0 million m^3 of LLW and 480,000 m^3 of MLLW will require disposal at facilities operated by the Waste Management program.

- Treatment and volume reduction technologies will further reduce these LLW and MLLW volume projections, lessening disposal capacity requirements.

To meet LLW disposal requirements, the Department has current and planned available disposal capacity of 11.5 million m^3 and plans to send to commercial facilities approximately 1.6 million m^3 of LLW. Therefore, on a complex-wide basis the current and planned available disposal capacities of the Department's disposal facilities appear to be adequate for managing the projected LLW volumes for the foreseeable future. In addition, the volume of LLW requiring disposal likely will be less than the reported projections when the following two factors are considered:

- The analysis in this Report did not consider any volume reduction prior to disposal (a number of sites either have implemented or are evaluating significant volume reduction initiatives to reduce the volume of waste requiring disposal); and

- A waste minimization strategy for LLW is being developed as part of Task VIII.3.a of the Defense Nuclear Facilities Safety Board Recommendation 94-2 Implementation Plan (Revision I). As recommendations from this Task will be incorporated into the Department's waste minimization program, the volume of waste requiring disposal will be reduced.

In addition, should future LLW projections exceed those contained in this Report, a number of steps could be taken to accommodate the increased disposal needs. Several potential on-site Department of Energy disposal facilities were not included in this analysis because they are considered very preliminary. Should additional disposal needs be projected, these facilities could be developed. In addition, the Department is investigating the increased use of commercial disposal facilities.

While this analysis determined that there is adequate disposal capacity on a complex-wide basis, changes in site-specific waste management and disposition strategies (e.g., increased volume reduction, off-site shipment configuration, greater use of commercial facilities, and increased on-site disposal) may be required. A site-specific summary of LLW disposal capacity follows:

- Fernald Environmental Management Project has planned sufficient disposal capacity for all of its on-site disposal projections.

- Hanford Site's waste management and environmental restoration disposal facilities have sufficient volumetric disposal capacity to meet the projected waste disposal requirements through the projected life cycle of operations.

- Idaho National Engineering Laboratory will have sufficient on-site disposal facility capacity through FY 2020 by employing waste minimization and other planned volume reduction initiatives.

- Los Alamos National Laboratory has sufficient volumetric capacity in current and planned disposal facilities through the projected life cycle of operations.

- Nevada Test Site has sufficient volumetric capacity in current and planned disposal facilities through the projected life cycle of operations.

- Oak Ridge Reservation currently does not have sufficient volumetric disposal capacity for the projected LLW volumes. Oak Ridge Reservation is investigating other waste management options and currently is waiting for approval to ship LLW to Nevada Test Site.

- Rocky Flats Environmental Technology Site has planned sufficient volumetric disposal capacity to meet its on-site waste disposal projections.

- Savannah River Site has sufficient volumetric capacity in current and planned disposal facilities through the projected life cycle of operations.

LLW projections will evolve in response to changes in projection methodologies and/or disposition strategies. Projections of waste resulting from environmental restoration activities are particularly sensitive to factors such as land use assumptions, available technologies, and cleanup levels. As LLW projections are revised, disposal capacity plans will be revised accordingly. In addition, increased coordination between the Environmental Restoration and Waste Management programs is needed on waste projection and disposal capacity issues.

5.0 Conclusions and Related Activities

As a result of the analysis performed, the following conclusions can be drawn:

1. *Improved LLW and MLLW projections are required for planning purposes.*

   While recent data collections have improved the quality of LLW and MLLW projections, additional work remains. This need was confirmed recently by the Complex-wide Review of the LLW system. The projections developed for the Integrated Database Report, Baseline Environmental Management Report, and Environmental Restoration Core Database and used in this Report represent an initial step in the development of an integrated view of the amount of LLW to be generated by the Department's cleanup effort and other missions. The projections ranged in quality from low (best professional judgement) to high (based on actual characterization data). The projections program guidance document scheduled for release in December 1996 will further develop and improve the quality of the data, definitions, and coordination between programs.

2. *The current and planned capacities of the Department's disposal facilities appear to be adequate for managing the projected LLW volumes for the foreseeable future.*

   A comparison of projected disposal volumes with volumetric disposal capacity indicates that the Department appears to have sufficient disposal capacity for LLW for the foreseeable future. However, an analysis using volumetric data and criteria provides only a very approximate estimate of disposal capacity. A more accurate evaluation of disposal capacity requires radiological and performance assessment information. Revision 1 will include an evaluation of radiological data and is scheduled for release in September 1997.

3. *Increased coordination between the Environmental Restoration and Waste Management programs is needed on waste projections and disposal capacity issues.*

   Conducting performance assessments and determining disposal capacity from a radiological perspective requires an evaluation of all radiological sources. A cumulative radiological analysis is required when determining disposal capacities for facilities operated by the Waste Management program and the Environmental Restoration program at a given site when source term interaction exists.

4. *The Department plans to work in partnership with commercial disposal facilities to manage large volumes of LLW and MLLW.*

   The Department projects that 1.6 million m^3 of LLW and 35,000 m^3 of MLLW from environmental restoration activities will be transferred to commercial disposal activities approximately over the next 40 years.

The following efforts examining LLW and MLLW management strategies and configuration are underway and may impact the Department's current LLW and MLLW management strategies.

- In its implementation of the Federal Facility Compliance Act, the Department is evaluating MLLW disposal capacity.

- As part of the Defense Nuclear Facilities Safety Board's Recommendation 94-2, the Department is conducting the systems engineering evaluation and the all source terms analysis of its LLW management system.

- When finalized, the Department's Waste Management Programmatic Environmental Impact Statement will guide reconfiguration of the management of LLW, including expansion and/or construction of disposal facilities within the complex. The Record of Decision based on the Waste Management Programmatic Environmental Impact Statement and subsequent site-specific environmental impact statements will address the future disposal capacity needs within the complex. In addition, the Record of Decision will incorporate the results of the evaluation being conducted as part of the implementation of the Federal Facility Compliance Act, the systems engineering evaluation, and the all source term analysis.

The Environmental Management program also is currently preparing a Ten Year Plan to complete cleanup at most nuclear sites within a decade. The results of the Ten Year Plan may impact both the amount and rate of LLW to be generated in the future and the Department's management strategy for the waste. However, at this time such impacts are expected primarily to affect the timing of waste transfers to disposal, and any impacts relative to the type of disposal management to be selected are not yet known.

Appendix A: Disposal Facility Summaries

This appendix summarizes the disposal facilities located at eight Department of Energy sites discussed in the Report. The Appendix is organized by site (Hanford Site is the only site with both Environmental Restoration program-operated and Waste Management program-operated disposal facilities). Each of the site summaries provides brief background information (such as location and historical activities on the site), disposal facility description (current status, waste streams projected for disposal at that facility, and general design features), and disposal capacity.

A.1 Fernald Environmental Management Project

A.1.1 Background

Location: Located approximately 18 miles northwest of Cincinnati, Ohio, the site covers a 1,050-acre area. The site includes a 136-acre industrial area.

Historical Activities: Fernald Environmental Management Project began operation in 1951 as the Feed Materials Production Center. Over 500 million pounds of high-purity uranium metals for use in nuclear weapons were produced there before its closure in 1989.

A.1.2 Facility Description

Status: The Fernald Environmental Management Project disposal facility will be operated under the Comprehensive Environmental Response, Compensation, and Liability Act. The Conceptual Design Report for the disposal facility was completed in 1994; this document can be considered the transition from the Record of Decision to the final design stage. This document lays out assumptions, design criteria, data gaps, etc. for remediating the site (as well as the proposed land disposal facility for treated wastes).

Waste Materials: The almost 40 years of site activity produced over 2.3 million cubic meters of waste. These wastes can be found throughout Fernald Environmental Management Project's five operable units: the former production area, waste pits, silos, inactive flyash pile, and contaminated soils and groundwater. Radioactive wastes consist primarily of uranium, but thorium, radium, and radon are also present. Remediation of the uranium also should capture most of the other radioactive contaminants. In addition to the radioactive component of waste, there are numerous other hazardous materials present. These include solvents, asbestos, PCBs, and heavy metals. The storage silos, which are located to the west of the formal production area, are the source of the highest level of radioactivity at the site. Two of the silos contain K-65 material, generated from the processing of high grade uranium ores, and are sources of high concentrations of radium. Another silo contains "cold" metal oxide waste residues, which are left over from uranium extraction operations. The former production area includes not only contaminated structures and equipment, but also thousands of drums of waste to be disposed at an offsite location.

General Design Features: The objective of the facility is to limit migration of contaminants and remain stable for at least 1,000 years. To meet this objective the following features are included:

- 40-foot thick barrier of glacial overburden (silty clay) maintained between cell and Great Miami Aquifer;
- a basal liner composed of multiple layers of clay, gravel, and geosynthetic liner that direct any liquids into the leachate collection system;
- a leachate collection system (not integral to success of cell);
- material placed in cell compacted into layers to inhibit settling; and
- a multicomponent cover with components to limit radon emissions (compacted clay), water infiltration (geomembrane), and biointrusion (cobblestones). The cell is sloped to deter long-term erosion and inhibit water infiltration.

The cell footprint is approximately 72 acres; the basal liner is approximately 6.5 feet thick; and the cover is approximately 10 feet thick.

A.1.3 Disposal Capacity

Only materials with low levels of contamination originating at Fernald Environmental Management Project will be disposed in this cell. The disposal cell will have a capacity for 1.8 million m^3.

A.1.4 References

"Recommendations on Remediation Levels, Waste Disposition, Priorities, and Future Use," July 1995, The Fernald Citizens Task Force.

A.2 Hanford Site

A.2.1 Background

Location: Managed by the Department, Hanford Site covers approximately 1,500 km^2 (500 mi^2) of government-owned land and is located northwest of the city of Richland, Washington, on the Columbia Plateau; it is bounded on the north by the Saddle Mountains, on the east by the Columbia River, and on the south and west by the Yakima River and the Rattlesnake Hills, respectively.

Historical Activities: In early 1943, the U.S. Army Corps of Engineers selected Hanford Site as the location for reactor, chemical separation, and related facilities and activities involving the production and purification of plutonium. Both the Waste Management and Environmental Restoration programs operate disposal facilities at Hanford Site. A.2.2 details the 200 Area Low-

Level Burial Ground (operated by the Waste Management program), and A.2.3 details the Environmental Restoration Disposal Facility (operated by the Environmental Restoration program).

A.2.2 200 Area Low-Level Burial Ground

A.2.2.1 Facility Description

Status: The 200 Area Low-Level Burial Ground is classified as a shallow landfill disposal facility, which covers an area of about 660 ha (1,500 acres). Shallow land disposal of solid waste has occurred at Hanford Site since the late 1940s.

Waste Materials: Until 1970, when the Atomic Energy Commission required that transuranic waste be retrievably stored, no distinction was made between transuranic waste and LLW. In the early 1980s, low-level liquid organic waste was segregated from LLW and stored (retrievably) underground. LLW currently being disposed at Hanford Site consists of many waste streams derived from numerous sources, both on-site and off-site.

General Design Features: The landfill is divided into eight burial grounds, two of which are located in the 200 East Area, and six of which are located in the 200 West Area. The current method of disposing LLW is in unlined, sloped (about 45 degrees) trenches that are about 6 to 7 m deep and vary in length up to apprximately 500 m. Trenches are typically wide-bottomed (about 8 m wide) or V-shaped (about 3 m wide). Packaged waste in carbon-steel, 55-gallon drums, or wooden boxes is stacked to within about 2.5 m of the surface. In 1987, MLLW was distinguished from LLW, and its disposal was largely discontinued, except on a case-by-case basis. Two types of MLLW typically considered for disposal in the pre-1987 trenches are remote-handled MLLW (with exposures greater than 200 mrem/hr at the container surface) and special waste. Special waste includes unique waste requiring special handling or unusual waste such as decommissioned reactor vessels. Non-remote-handled MLLW is currently stored in above ground buildings. Ultimately, MLLW will be disposed of in a new, Resource Conservation and Recovery Act-compliant disposal facility located within the Low-Level Burial Ground 218-W-5 in the 200 West Area.

A.2.2.2 Disposal Capacity

The amount of waste received by the Low-Level Burial Ground is highly variable and may differ greatly from year to year because of changes in the nature or level of cleanup activities on and off Hanford Site. An engineering study is planned to optimize the total capacity for LLW disposal facilities within the 200 Areas. Engineering estimates indicate that about 85,000 m^3 of space is available for LLW in the 218-W-5 burial ground, and upon completion of construction of the MLLW trenches, at least 43,000 m^3 will be available. The volume for MLLW wil! increase with planned waste loading optimization of the Resource Conservation and Recovery Act-compliant disposal space. Other burial grounds in the 200 Area have an additional 1.1 million m^3 of current and planned available LLW disposal capacity.

A.2.3 Environmental Restoration Disposal Facility

A.2.3.1 Facility Description

Status: The Environmental Restoration Disposal Facility is regulated by the Comprehensive Environmental Response, Compensation, and Liability Act; its Record of Decision was signed in January 1995. This document discusses site and risk assessments, remedial alternatives, the selected remedy, and statutory determinations for the Hanford Site disposal facility. Construction of the first two cells is underway and operations should begin by August 1996. For the purposes of this Report, this facility is considered current.

Waste Materials: Hanford Site waste accounts for nearly 2/3 by volume of the nuclear waste in the Department of Energy complex. The site contains vast amounts of both radioactive and hazardous wastes. Currently, 10% of Hanford Site's waste is radioactive and 75% is mixed waste. The most abundant contaminants are tritium, carbon tetrachloride, chromium, nitrates, cobalt, strontium, cesium, technetium, iodine, plutonium, and uranium. In the Record of Decision, the total volume of waste potentially projected is cited as less than 21 million m^3. More recent projections indicate that approximately 3.9 million m^3 of LLW and MLLW will be disposed at the Environmental Restoration Disposal Facility.

General Design Features: The Environmental Restoration Disposal Facility is a 70-foot-deep trench composed of two cells (in the initial phase). Each cell is 500 feet by 500 feet at the base. The objective of the facility is to limit migration of contaminants and prevent intrusion for at least 500 years. To meet these objectives, the following features are included:

- a double-lined basal liner composed of multiple layers of clay and geosynthetic liner that direct any liquids into the leachate collection system;
- a leachate collection system; and
- a multicomponent cover with components to limit radon emissions (clay), infiltration (geomembrane and an extra 15 feet of soil), and biointrusion (sand and gravel). The cell is sloped to deter long-term erosion and inhibit water infiltration.

The cell footprint may eventually cover an area approximately 1.6 square miles in size. The initial phase footprint is approximately 165 acres.

A.2.3.2 Disposal Capacity

Only Hanford Site waste resulting from remediation of the 100, 200, and 300 Areas will be disposed in the Environmental Restoration Disposal Facility. The initial two cells will have a capacity of 0.9 million m^3. The Environmental Restoration Disposal Facility Record of Decision states that all projected waste (listed in the Record of Decision as less than 21 million m^3) may be disposed in the Environmental Restoration Disposal Facility. Current projections indicate that 3.9 million m^3 of LLW will be disposed in the Environmental Restoration Disposal Facility.

A.2.4 References

"Record of Decision for the U.S. DOE Hanford Environmental Restoration Disposal Facility, Hanford Site," January 1995.

"Hanford Site Environmental Report for Calendar Year 1992" (PNL-8682, UC-602), 1992, R.K. Woodruff, R.W. Hanf, and R.E. Lundgren, Pacific Northwest Laboratory, Richland, Washington.

Personal communication with Dean Pratt, Westinghouse Hanford Company, regarding correspondence to Steve Storch, IDB Program, ORNL, Oak Ridge, Tennessee, "LLW Data Call," dated July 17, 1995.

"Low-Level Waste Burial Ground Disposal Plan" (WHC-SD-WH-ES-355).

A.3 Idaho National Engineering Laboratory

A.3.1 Background

Location: Idaho National Engineering Laboratory covers nearly 2,300 km^2 (890 mi^2) in Southern Idaho. Idaho National Engineering Laboratory is located within the Medicine Lodge Resource Area and the Big Butte Resource Area, both of which are administered by the Bureau of Land Management.

Historical Activities: In 1949, the site was established as the National Reactor Testing Station, where the Atomic Energy Commission built, tested, and operated various types of nuclear reactors. As of April 1991, 52 reactors had been built at Idaho National Engineering Laboratory, and 13 were still operating or operable. Idaho National Engineering Laboratory is now a multiprogram laboratory with numerous research and site cleanup activities. One LLW disposal facility, the Radioactive Waste Management Complex, is presently operating at Idaho National Engineering Laboratory. The Radioactive Waste Management Complex is located in the southwest portion of the site. Idaho National Engineering Laboratory does not plan to build another disposal facility: Idaho National Engineering Laboratory is currently evaluating disposal options at Envirocare, Hanford Site, and Nevada Test Site.

A.3.2 Radioactive Waste Management Complex

A.3.2.1 Facility Description

Status: The Radioactive Waste Management Complex was established in 1952 for disposal of defense wastes (mostly transuranic), solid LLW, and MLLW generated at Idaho National Engineering Laboratory. Since 1970, transuranic waste has been stored above ground in specially designed storage facilities, and no mixed waste has been disposed at the complex since April 1984.

Today, the facility provides waste management, interim storage of transuranic waste, and disposal of Idaho National Engineering Laboratory-generated LLW, but provides no means for disposing of MLLW. The facility also retrieves, examines, and certifies stored transuranic waste for ultimate shipment to the Waste Isolation Pilot Plant in Carlsbad, New Mexico.

Waste Materials: Buried waste and retrievably-stored waste include solid beta-gamma contaminated LLW from Idaho National Engineering Laboratory operations, transuranic waste, and contaminated soil. Buried waste is subdivided into contact-handled and remote-handled waste. The beta-gamma contaminated LLW and contaminated soil contain transuranic contaminants less than 100 nCi/g. The buried waste, beta-gamma LLW, and soil are classified as LLW. A 1989 study of a representative section of the Radioactive Waste Management Complex containing the transuranic waste determined that 46% of all past disposed transuranic waste (64,755 m^3) is to be reclassified as LLW. This study also concluded that 95% of the disposed transuranic waste inventory contains hazardous constituents and will be reclassified and managed as MLLW.

General Design Features: The 58-ha (144-acre) complex consists of two main disposal and storage areas: the Transuranic Storage Area for storage and examination of transuranic waste and the Subsurface Disposal Area for disposal of LLW. The Subsurface Disposal Area is a 36 ha (88 acre) fenced area surrounded by a flood control dike and drainage channel. The Subsurface Disposal Area consists of Pad A, trenches, pits, and soil vaults. Two LLW disposal areas are operational: pits and soil vaults. Pits are used to dispose of solid beta/gamma contact-handled LLW. The pits are 30 m x 4 to 6 m (98 ft x 12 to 20ft) and vary from 60 to 360 m (200 to 1,200 ft) long. Pits are generally excavated to bedrock depth, and the bedrock is covered with soil. After the waste is placed on the soil by high density stacking, the pits are backfilled. Soil vaults are unlined, augured boreholes between 0.41 and 1.8 m (16 to 72 in) in diameter used to dispose of remote-handled LLW. The waste is usually placed into the vaults in bottom discharge shielded casks. When the vaults are full, they are covered with soil. Approximately 210,000 m^3 of LLW was disposed of in the Subsurface Disposal Area (1952-1992). Although there are no plans to expand the existing Radioactive Waste Management Complex Subsurface Disposal Area, new disposal concepts are being evaluated to establish environmental compliance plans and functional and operational requirements for new disposal facilities.

A.3.2.2 Disposal Capacity

The Subsurface Disposal Area has an original disposal capacity of 250,000 m^3. As of January 1993, the remaining capacity in the current active pits was 39,000 m^3. After the year 2000, the complex will be closed to active waste disposal, and periodic monitoring and maintenance activities will be conducted. A new state-of-the-art facility will be developed to replace the Radioactive Waste Management Complex.

A.3.3 References

"Idaho National Engineering Laboratory (INEL) Site Specific Plan for Fiscal Year 1994" (DOE/ID-10253).

"Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Pre-Decisional Draft (Rev. 2) Environmental Impact Statement" (DOE/EIS-0203), April 1994.

A.4 Los Alamos National Laboratory

A.4.1 Background

Location: Los Alamos National Laboratory is located on the Pajarito Plateau in Los Alamos County in north-central New Mexico, approximately 97 km (60 mi) north-northeast of Albuquerque and 40 km (25 mi) northwest of Santa Fe. Los Alamos National Laboratory occupies an area of 112 km^2 (43 mi^2), bounded on the southeast by the Rio Grande.

Historical Activities: The University of California has managed Los Alamos National Laboratory since 1943, and the Department has been the designated federal landlord since 1978. Los Alamos National Laboratory's mission involves the application of science and technology to weapons development, energy supply, and conservation programs.

Los Alamos National Laboratory has one operating facility (Technical Area-54MDA Area G) and one planned facility (Technical Area-67); each is discussed in turn.

A.4.2 Technical Area-54 MDA Area G

A.4.2.1 Facility Description

Status: Beginning in 1957, Area G within Technical Area-54 was used to dispose of waste generated from operations involving radioactive materials and waste that would now be classified as mixed waste.

Waste Materials: In 1970, the Atomic Energy Commission directed its facilities to begin storing transuranic waste so that it could eventually be retrieved. Los Alamos National Laboratory then began segregating LLW from transuranic waste and dedicating specific areas within Area G for management of these wastes. Since 1986, LLW has been segregated for storage at Technical Area-54 Area G.

General Design Features: Area G occupies 64 acres and currently consists of 39 landfill cells (pits and trenches) and 237 land disposal shafts. An additional 24 acres, immediately adjacent to Area G, is dedicated for future expansion of the LLW disposal area.

A.4.2.2 Disposal Capacity

Four disposal units within Area G are active for disposal of LLW and asbestos LLW. Closed units include 36 landfill cells (pits and trenches) and 208 land disposal shafts. Current remaining disposal capacity is approximately 24,000 m^3. Future construction will provide for the disposal of an additional 280,000 m^3 of waste.

A.4.3 Technical Area-67

The second site at Los Alamos National Laboratory used for LLW disposal is Technical Area-67, located in the west-central portion of Los Alamos National Laboratory and bounded on the north by Pajarito Canyon and on the south by Three Mile Canyon. Technical Area-67 is the projected location of the Mixed Waste Disposal Facility. The capacity for the Technical Area-67 Mixed Waste Disposal Facility was planned at approximately 400,000 m^3. The planned Technical Area-67 disposal facility is very preliminary; therefore, its design capacity was not considered in the Report.

A.4.4 References

"Performance Assessment of the LANL TA-54 Area G LLW Disposal Facility," August 1995, Los Alamos National Laboratory.

"RFI Work Plan for Operable Unit 1148" (LA-UR-92-855), May 1992, Los Alamos National Laboratory, Los Alamos, New Mexico.

"RFI Work Plan for Operable Unit 1085 (DRAFT)," March 1994, Los Alamos National Laboratory, Los Alamos, New Mexico.

"RCRA Part B Permit Application, Volume 1" (Project No: 301608.07), September 1993, Los Alamos National Laboratory, Los Alamos, New Mexico.

Personal communication with Charles Peper, University of California, regarding correspondence to Alan Icenhour and Steve Storch, IDB Program, ORNL, Oak Ridge, Tennessee, "Subject Reports for 1995 Low-Level Waste," CST 14-95-383, dated July 31, 1995.

A.5 Nevada Test Site

A.5.1 Background

Location: Nevada Test Site is a Department of Energy nuclear testing facility occupying 3,500 km^2 (1,400 mi^2) of federally owned land in southeastern Nevada. Located about 105 km (65 mi) northwest of Las Vegas, the site is bordered to the west, north, and east by the Nellis Air Force Base Bombing and Gunnery Range and the Tonopah Test Range.

Historical Activities: Nevada Test Site has been the primary location for testing the nation's nuclear weapons and devices since 1951. Other functions include environmental restoration efforts throughout Nevada Test Site and operation of the Liquefied Gaseous Fuels Spill Test Facility. Waste disposal facilities for LLW and MLLW are located in Areas 3 and 5.

A.5.2 Area 3 Radioactive Waste Management Site

A.5.2.1 Facility Description

Status: The Area 3 Radioactive Waste Management Site is located on Yucca Flat and covers an area of approximately 20 ha (50 acres).

Waste Materials: Contaminated debris from the Nevada Test Site Atmospheric Testing Debris Disposal Program and packaged bulk LLW from offsite Department of Energy facilities are disposed in subsidence craters produced from underground nuclear tests using conventional landfill techniques.

Description: U3ahat is an active disposal cell that currently receives LLW from approved offsite generators. U3axbl is an inactive, covered disposal cell discontinued in January 1988. Because waste received in the past contained lead, U3axbl may contain mixed waste; formal closure will commence when the Resource Conservation and Recovery Act closure cap plan is approved. Three other sites in Area 3 are in reserve (U3az, U3bg, and U3bh).

A.5.2.2 Disposal Capacity

The total remaining capacity for LLW in the Area 3 Radioactive Waste Management Site is estimated to be 1.8 million m^3.

A.5.3 Area 5 Radioactive Waste Management Site

A.5.3.1 Facility Description

Status: Beginning in 1961, the Area 5 Radioactive Waste Management Site was used to dispose of LLW and classified LLW generated by Nevada Test Site operations.

Waste Materials: In 1978, Nevada Test Site began accepting LLW generated by off-site Department of Energy facilities. Pit 3 has received mixed waste in the past, but under agreement with the state has suspended receipt pending resolution of waste acceptance criteria. This landfill unit has accepted pondcrete, a mixture of MLLW sludge and cement, from the Rocky Flats Environmental Technology Site in Colorado. Pit 6, opened in 1990, and Pit 5, opened in 1995, are used for the disposal of LLW.

General Design Features: The total area allocated to the Area 5 Radioactive Waste Management Site is 296 ha (732 acres). The developed portion of Area 5 occupies 37 ha (92 acres) in the southeast corner and contains 17 landfill cells (pits and trenches), 13 Greater Confinement Disposal Units boreholes, and a Transuranic Waste Storage Pad. Three pits are currently in operation in Area 5, one for disposal of MLLW and two for disposal of LLW. Three trenches in Area 5 are operational and designated to receive classified LLW: Trench T07C, Trench T08C, and Trench T09C. Trenches T03U and T04C have been closed.

The Mixed Waste Disposal Unit (currently designed to consist of 10 cells) is a landfill proposed for location on about 18 ha (45 acres) of the Area 5 Radioactive Waste Management Site, immediately north of the developed Radioactive Waste Management Site landfill area. The design has been completed, the unit is included in the Resource Conservation and Recovery Act permit application, and the environmental assessment is being updated.

A.5.3.2 Disposal Capacity

The total remaining capacity for LLW in the Area 5 Radioactive Waste Management Site is estimated to be 1,200,000 m^3.

A.5.4 References

"Nevada Field Office Annual Site Environmental Report-1991" (DOE/NV/10630-33), September 1992, U.S. Department of Energy.

Carol Shelton, Nevada Operations Office.

"Site Book for Waste Management," May 1994, Reynolds Electrical and Engineering Co., Inc.

Personal communication with Carlos Gonzales, Reynolds Electrical & Engineering Company, Inc., regarding correspondence to Jou Hwang, The Cadmus Group, Inc., Maryland, "Existing and Planned Low-Level Waste (LLW) Facility Tables for the 1995 Integrated Data Base (IDB)," dated September 7, 1995.

A.6 Oak Ridge Reservation

A.6.1 Background

Location: The Oak Ridge Reservation is located in a valley between the Cumberland and southern Appalachian Mountain ranges in eastern Tennessee about 10 km west of Knoxville. Oak Ridge Reservation covers an area of 35,252 acres and contains three major facilities: Oak Ridge National Laboratory, Oak Ridge K-25 Site, and Oak Ridge Y-12 Plant.

Historical Activities: Oak Ridge Reservation is located in the west end of Bethel Valley and was originally constructed as a research and development facility to support plutonium production and research. Today, the facility conducts research on the fission nuclear fuel cycle and nuclear fusion.

Oak Ridge National Laboratory is the only facility of the three at Oak Ridge Reservation which operates a disposal site for LLW, Solid Waste Storage Area 6.

A.6.2 Facility Description

Status: Located in the southwest region of Oak Ridge Reservation, the 28-ha (68-acre) Solid Waste Storage Area 6 has been used by Oak Ridge National Laboratory since 1969 for the disposal of on-site generated LLW. Until 1986 all LLW generated at Oak Ridge National Laboratory (including MLLW) was disposed of by shallow land burial, generally in unlined trenches and auger holes. This practice came under closer scrutiny by Federal and State regulators and Department of Energy officials, and as a result in 1986, major changes in the operation of Solid Waste Storage Area 6 were initiated. Because of the disposal practices conducted before 1986, some areas in Solid Waste Storage Area 6 were remediated under a Resource Conservation and Recovery Act interim status closure agreement with the Tennessee Department of Environment and Conservation. The remediation activities were coordinated with ongoing Greater Confinement Disposal units waste operations. Remediation of Solid Waste Storage Area 6 will occur under the Comprehensive Environmental Response, Compensation, and Liability Act.

Waste Materials: Solid Waste Storage Area 6 does not accept any mixed waste for disposal. A new radioactive solid waste disposal facility, the Interim Waste Management Facility, was also constructed during this period for interim solid LLW disposal until long-term facilities become available. Solid Waste Storage Area 6 is also the currently active disposal site for fission-product LLW in Greater Confinement Disposal units and for suspect waste in shallow land burial units.

General Design Features: Below-grade disposal methods used at Solid Waste Storage Area 6 include concrete silos, wells in concrete silos, pipe-lined auger hole wells, unlined trenches, and landfills. Oak Ridge National Laboratory began phasing out some of the below-grade disposal operations in December 1992 at a Tennessee Department of Environment and Conservation request because of concerns about shallow land disposal in the trenches and landfill and concerns that the wells would not meet the long-term performance objectives of Department of Energy Order 5820.2A. The wells in concrete silos and the pipe-lined auger hole wells are still used for retrievable storage of very high range remote-handled LLW. The landfill was also closed in 1992 for disposal of very low activity waste. The unlined trenches were phased out for animal wastes in 1992 and for other biological wastes in early 1993.

The Interim Waste Management Facility is the only active above-grade tumulus disposal facility in Solid Waste Storage Area 6, occupying an area of approximately 3.8 ha (9.5 acres) in the southwest portion of Solid Waste Storage Area 6. The Interim Waste Management Facility began operation in December 1991 and will provide interim disposal for contact-handled LLW. The original facility was designed for six tumulus pads. Each tumulus pad is approximately 18.2 m x 27.4 m (60 ft x 90 ft) and 30.5 cm (12 in) thick, constructed using high-density concrete and reinforced with epoxy-coated steel. The pad has concrete curbs 0.30 m (1 ft) high on the north, south, and west sides. The east side is used for vehicle access. Each pad provides disposal for approximately 330 vaults (approximately 897 m^3) stacked three high. The Interim Waste Management Facility is designed to divert water into three sumps, located in a monitoring station adjacent to the tumulus pads. The monitoring station is equipped for receiving, monitoring, and collecting samples from flows received from the storm water, underpad, and infiltration drain systems. The underpad sump is designed to allow monitoring of any groundwater that may accumulate under the pads. The storm water sump collects water from the pad that is in operation. The infiltration sump is used to collect water from the pads that have been filled with vaults. A principal feature of tumulus disposal is the inherent capability for monitoring groundwater and surface water for contamination. The sealed concrete pad is the primary barrier from the groundwater. The pad is sloped 1 percent to one side where a curb and gutter collects all surface pad runoff and drains the water to a monitoring station. A liner below the pad provides a secondary barrier from the groundwater and collects any water that may have penetrated the pad, which is then also diverted to the monitoring station.

Other auxiliary facilities at the Interim Waste Management Facility include the following: the Waste Classification and Certification Facility; Class L-III/L-IV Above Ground Storage (for long-term storage and monitoring requirements for Class L-III/L-IV solid LLW); and the Bulk Contaminated Soil Facility.

A.6.3 Disposal Capacity

The remaining disposal capacity of the Interim Waste Management Facility pads is 6,700 m^3.

A.6.4 References

"Performance Assessment for Continuing and Future Operations at Solid Waste Storage Area 6" (ORNL-6783), February 1994, Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee.

"Environmental Analysis of the Operations of Oak Ridge National Laboratory (X-10 Site)" (ORNL-5870), November 1982, Union Carbide Corp.

A. L. Rivera, Lockheed Martin Energy Systems, Inc., Tennessee, correspondence to S. N. Storch, IDB Program, ORNL, Oak Ridge, Tennessee, "Low-Level Waste (LLW) Management Data Call for 1995," dated July 31, 1995.

A.7 Rocky Flats Environmental Technology Site

The Rocky Flats Environmental Technology Site waste management complex is being planned to provide for on-site disposal capacity. The waste management complex comprises a sanitary waste disposal cell and a Resource Conservation and Recovery Act waste cell for LLW and MLLW generated through remediation activities with a capacity of approximately 77,000 m^3. Rocky Flats Environmental Technology Site is also evaluating whether to site a Resource Conservation and Recovery Act-permitted MLLW disposal cell at this facility (capacity approximately 77,000 m^3).

A.7.1 Background

Location: Located about 16 miles northwest of Denver in Jefferson County, CO, Rocky Flats Environmental Technology Site covers 11 square miles, including a buffer zone, and consists of production facilities, laboratories, and storage areas.

Historical Activities: From 1952 to 1989, Rocky Flats Environmental Technology Site's primary mission was the production of nuclear weapon components. Activities included metalworking, component assembly, and plutonium recovery and purification. Starting in 1989, manufacturing activities were reduced, and in 1992, production of nuclear components ceased altogether. The plant's mission shifted to environmental restoration.

A.7.2 Facility Description

Status: The Conceptual Design Report was completed in 1995; this document can be considered the transition from the Record of Decision to the final design stage. This document lays out assumptions, design criteria, data gaps, etc. for remediating the site (as well as the proposed land disposal facility for treated wastes). The Corrective Action Management Unit will be regulated under the Resource Conservation and Recovery Act. This facility will manage all environmental restoration LLW and MLLW requiring disposal.

Waste Materials: Buildings, surface water, groundwater, and soil at Rocky Flats Environmental Technology Site are contaminated with chemical and radioactive materials, such as plutonium, uranium, and americium. Volatile organic compounds, including cleaning solvents, are the most prevalent contaminants in surface water and groundwater. Most of the contaminated soil occurs near the 903 Pad temporary storage area. This soil contains plutonium particles that have escaped from steel storage drums.

General Design Features: The objective of the Waste Management Facility is to limit the migration of contaminants and remain stable for at least 1,000 years. To meet this objective the following features are included:

- a 20-foot-thick barrier of soil maintained between cell and uppermost aquifer;
- a basal liner composed of multiple layers of clay, gravel, and geosynthetic liner that direct any liquids into the leachate collection system;
- a leachate collection system;
- a passive gas venting system; and
- a multicomponent cover with components to limit radon emissions (2 feet of compacted clay), infiltration (geomembrane), and biointrusion (cobblestones), as well as to facilitate drainage (soil and gravel). The vegetated surface of the cell can deter long-term erosion and inhibit water infiltration.

The disposal cell is also designed to allow recovery of waste if necessary. Careful mapping and documentation of disposed waste will facilitate any recovery actions. A controlled survey point will be installed for grid-block mapping. The cell area is approximately 120 ft x 50 ft; the basal liner is approximately 6 ft thick; the cover is approximately 10 ft thick.

A.7.3 Disposal Capacity

Physical Capacity: Only Rocky Flats Environmental Technology Site waste will be disposed of in this cell. The disposal cell will have a capacity for 77,000 m^3 comprised of the following: investigation derived materials in drums; LLW/MLLW in boxes, drums, or other containers; and bulk remediation wastes, e.g., soils and demolition debris.

A.7.4 References

"Conceptual Design Report: Waste Management Facility for Rocky Flats Environmental Technology Site, Golden, Colorado," August 1995, U.S. Department of Energy, Rocky Flats Field Office.

A.8 Savannah River Site

A.8.1 Site Description

Location: Savannah River Site is located in south-central South Carolina and occupies an area of approximately 300 mi^2 (192,000 acres). Ranging from 25 m to 130 m above mean sea level, the site's major geophysical feature is the Savannah River, which forms the area's southwestern boundary.

Historical Activities: The U.S. government began constructing Savannah River Site in 1950. The facility's missions are site remediation and safe processing of nuclear materials. Westinghouse Savannah River Co. currently operates the E-Area Vaults. In 1987, the Department directed new disposal facilities constructed in humid climates to be "decoupled from the groundwater table." To comply with this directive, a project to build disposal vaults, called the E-Area Vaults, was initiated.

A.8.2 E-Area Vaults

A.8.2.1 Facility Description

Status: E-Area occupies a 78.9-ha (195-acre) area, approximately 10 km (6 miles) from the nearest plant boundary. All radioactive solid waste produced at Savannah River Site, as well as off-site Department of Energy shipments, are disposed in one centrally located site. The original 31-ha area began to receive waste in 1953 and was filled in 1972, when operations were shifted to a contiguous 48.1-ha site. In 1986, part of the site was closed and designated as a mixed waste facility because it contains hazardous material. Because these older facilities are filled, disposal is now shifted to the 40.5-ha (100-acre) E-Area Vaults to the north.

Waste Materials: LLW handled at E-Area Vaults is segregated into three categories: Low Activity Waste, Intermediate Activity Waste, and Tritiated Waste. Waste material that radiates ≤200 mR/hr at 5 cm from an unshielded container is designated as Low Activity Waste. Intermediate Activity Waste is defined as LLW that produces a radiation dose rate ≥200 mR/hr at 5 cm from an unshielded container. Tritiated waste is waste material that contains greater than trace quantities of tritium (trace quantity is defined as ≤10 Ci of H^3 per waste container) regardless of the radiation rate. Low Activity Waste containing only trace quantities of H^3 is disposed in the Low Activity Waste Vault. All wastes containing greater than trace quantities of H^3 are disposed of the Intermediate Level Tritium Vaults. Intermediate Activity Waste containing only trace quantities of H^3 is disposed in the Intermediate Level Non-Tritium Vaults. Currently, one Low Activity Waste vault and one Intermediate Level Vault have been constructed: one more of each is planned to be operational by the end of 2005. Eventually, 18 Low Activity Waste vaults and eight Intermediate Level Vaults will be constructed contingent upon funding and Department of Energy approval.

General Design Features: Each Low Activity Waste vault is 643 ft long by 145 ft wide by 27 ft tall. Two vaults each have approximately 32,000 m^3 of disposal capacity and 19 vaults each have approximately 48,000 m^3 of disposal capacity. Each Intermediate Level Non-Tritium Vault is 189 ft long by 48 ft wide by 29 ft tall with approximately 5,700 m^3 of disposal capacity for each of the 10 vaults. The tritium vaults are structurally identical to the Intermediate Level Non-Tritium Vault except for the length, which is only 57 ft. The tritium vaults have a disposal capacity of 1,613 m^3 for each of the 10 vaults.

A.8.2.2 Disposal Capacity

E Area Vaults have current and planned capacity of approximately 1,100,000 m^3 of LLW.

A.8.3 References

"Location Standards Demonstration, Hazardous Waste/Mixed Waste Disposal Vaults, Rev. 0", September 30, 1993.

Nathaniel S. Roddy, Westinghouse Savannah River Company, South Carolina, correspondence to Steven Storch, IDB Program, ORNL, Oak Ridge, Tennessee, "Low-Level Waste (LLW) Management Data Call for 1995," SWE-SWE-95-0357, dated July 31, 1995.

"Radiological Performance Assessment for the E-Area Vaults Disposal Facility," Westinghouse Savannah River Company.

"RCRA Part B, Volume IX, Hazardous Waste/Mixed Waste Disposal Vaults" (WSRC-IM-91-53), September 30, 1993.